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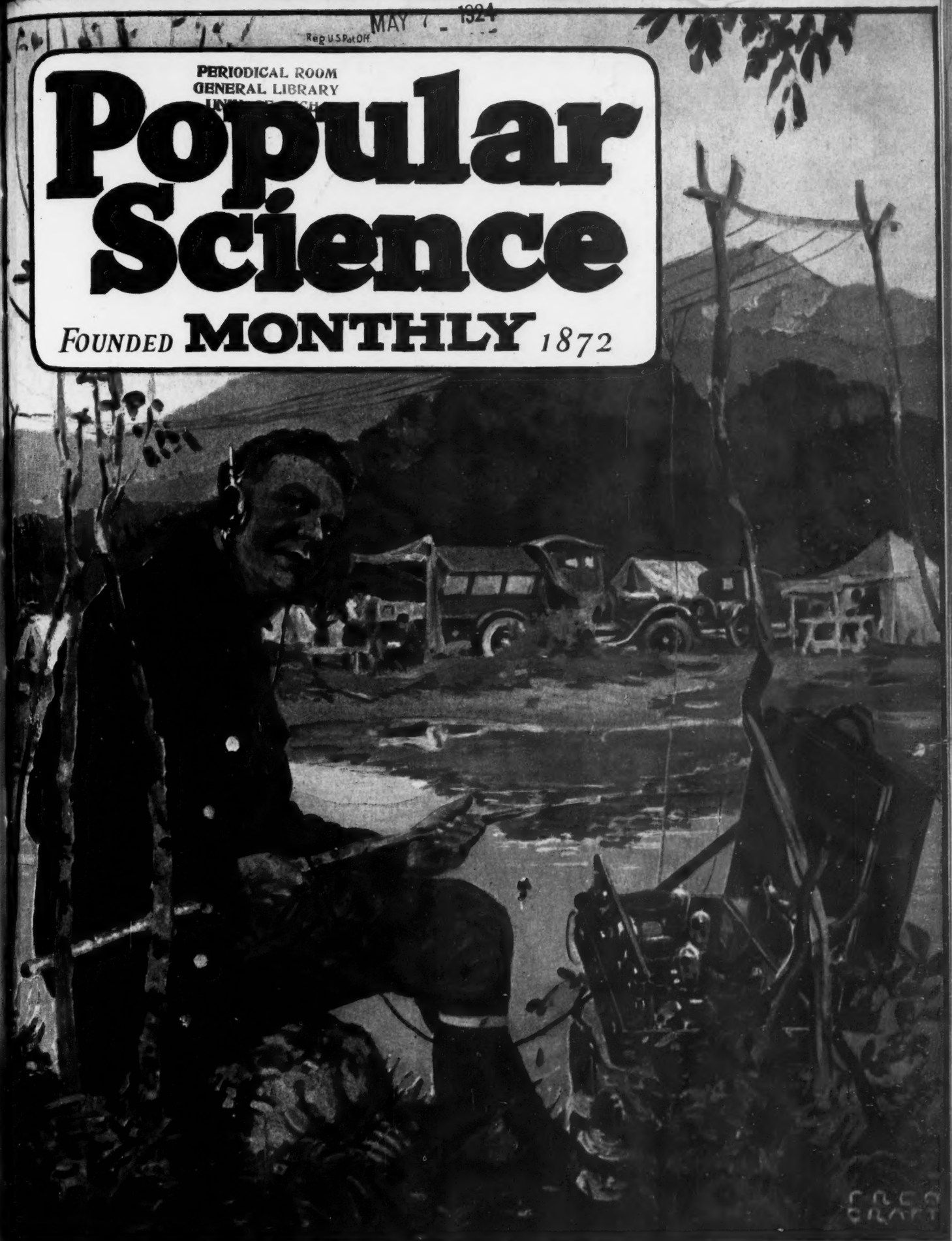
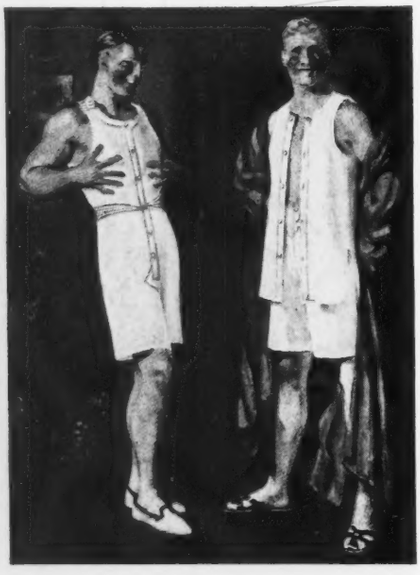


Portable Radio for Your Auto Vacation

See page 68

JUNE 25 CENTS



"Next to Myself I Like 'B.V.D.' Best"

Cool Men Know Why They Prefer "B.V.D."

"B.V.D." developed an entirely new principle which completely revolutionized under dress.

For its Coolness, Comfort, Long Wear and Famous Fit, "B.V.D." is *everywhere* the underwear of men who demand these qualities in their Undergarments.

From raw cotton to the finished garment, in every stage of manufacture, ceaseless care assures the Unvarying Quality which has brought world wide preference for "B.V.D."

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There Is Only One "B.V.D." Underwear

It Is Always Identified By This Red Woven Label

MADE FOR THE B.V.D. BEST RETAIL TRADE

(Trade Mark Reg. U.S. Pat. Off. and Foreign Countries)

"B.V.D." Union Suit

Men's $1.50 the suit, Youths' 85c

"B.V.D." shaped elastic insertions at shoulders and ***encircling*** waist make these cool, loose-fitting undergarments instantly responsive to your slightest movement. These ***ever-elastic*** insertions are knitted by us on spring needle machines from yarns spun from selected cotton in our own yarn mill.

The perfect "B.V.D." closed crotch (patented) completely covers the crotch ***without surplus trunk length*** and uncomfortable needless material at crotch or seat.

The patented elastic shoulder construction and waist band reinforcement are additional guarantees of comfort and long wear.

"B.V.D." Shirts and Drawers

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"B.V.D." Coat Cut Undershirts and Knee Length Drawers are the ***constant choice*** of millions of men who wear two-piece underwear. They know that they are correctly cut as to size and that there is a shapeliness to the garments that make them hang smoothly and evenly with neither too much nor too little fullness.

The garments are tailored with noticeable balance and drape, which they retain no matter how long worn or how often washed.

The B.V.D. Company, Inc., New York

Sole Makers of "B.V.D." Underwear

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In 24 Days the Crosley Model 51 Became the Biggest Selling Radio Receiver in the World!

ON Monday morning, February 4th, Powel Crosley, Jr., returned to his desk after a two week's hunting trip in Mississippi. He brought with him the idea of an entirely new Radio Receiving Set to be added to the Crosley line.

A short conference with his engineers followed. On Tuesday morning, February 5th, a model had been completed and tested. These sets were put into production immediately after the model was approved.

On Tuesday afternoon, February 5th, night letters were sent to the leading distributors of The Crosley Radio Corporation announcing this new model which had been called MODEL 51. Wednesday afternoon, the orders commenced coming in, showing the faith of the distributors in anything brought out by this Company. Announcements were made in leading metropolitan newspapers of the country on Saturday and Sunday, February 9th and 10th. Shipments commenced about February 13th, and were immediately followed by an avalanche of complimentary letters and orders, and have increased steadily ever since.

Production started at 50 a day—was increased to 200—then 300—and on February 28th, just 24 days after the thought of this set had been put into being, the production reached 500 a day. Orders were received on February 28th for 1,115 of these sets—every effort being made to increase the production to 3,000 sets per day to supply the phenomenal demand for this new model.

This message was written on February 29th in the face of promises of an even greater record than is indicated here.

The demand for this set has not in any way lessened the sale but has increased the orders on various other models in the Crosley line.

Now what is this set that has made such an enviable record, which in 24 days has, we believe, become the biggest selling radio receiving set on the market?

It incorporates a tuning element made famous in the Crosley Model V, the $16.00 set used by Leonard Weeks of Minot, N. D., in his consistent handling of traffic with the MacMillan Expedition at the North Pole; a genuine Armstrong regenerative tuning and detective circuit.

Now, to this has been added a one stage of audio frequency amplification. With the well-known Crosley Sheltran 9 to 1 ratio transformer, giving an unusual volume. Thus, this set uses 2 vacuum tubes.

It is the ideal all-around receiver. For local and nearby broadcasting stations, it will operate a loud speaker, giving phonograph volume in the home. Under reasonably good receiving conditions, it will bring in stations up to 1,000 miles, with sufficient volume for the average sized room.

When receiving conditions are bad, however, head phones should be used on distant stations.

This Receiver is unusually selective—it incorporates standard sockets so that all makes of tubes can be used. The various units are mounted on beautifully engraved grained panels, and mounted in a hardwood, mahogany finished cabinet, which completely encloses all parts and tubes.

A glance at this beautiful instrument sells it, and the results it gives creates many friends for it. Perhaps the most startling thing of all is its price—$18.50. Add 10% West of the Rocky Mountains.

Licensed under Armstrong Regenerative Patent No. 1,113,149.

THE CROSLEY RADIO CORPORATION

Powel Crosley, Jr., *President*

Formerly

The Precision Equipment Company and Crosley Manufacturing Company

617 ALFRED STREET CINCINNATI, OHIO

CROSLEY

Better—Cost Less Radio Products

Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

JUNE, 1924; Vol. 104, No. 6
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

In the July Issue

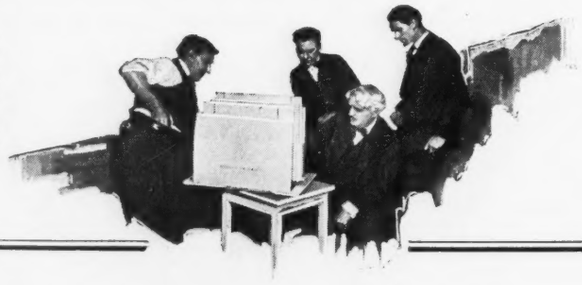
David Belasco recalls his 40 years of inventive experiment in producing the ideal stage illumination, "a true semblance of sunshine." A delightful article by the dean of American theatrical producers, containing useful suggestions for lighting the home attractively.

It's Presidential Year. For the first time in history the thrill of the big party conventions, the speeches of candidates, the views of statesmen, all will be carried first hand, far beyond the limits of convention halls and platforms, to a vast audience of men and women voters. A timely article next month will open your eyes to the tremendous part that radio, the new campaigner, will play in nominating and electing our next President. Other articles in the same issue will help you keep in step with the swift progress of radio science.

Automobiles that fly soon may carry you to work every morning. So says Capt. E. V. ("Eddie") Rickenbacker, Ace of Aces in the World War, and now a successful automobile manufacturer. Captain Rickenbacker's fascinating predictions of the winged motor car are based on spectacular years of experience as auto race driver, army flier, and automobile designer. They are embodied in an article he has prepared for the July issue.

Not one in 200 families knows how to eat right! That astounding conclusion, drawn from an actual canvass of 200 American dinner-tables, comes from Walter H. Eddy, Ph.D., Professor of Physiological Chemistry, Teachers College, Columbia University, and one of America's foremost authorities on diet and nutrition. In an unusually helpful article Doctor Eddy not only translates into understandable language the principles of scientific nutrition, but he shows how easy it is to eat the food you like in a way that will make you healthy and happy.

And more than 200 other fascinating articles and pictures giving you all the news of science and invention, together with practical ideas for radio, the automobile, the home, the home workshop, and the use of tools and machinery.



David Belasco and his staff of electricians in the lighting "laboratory" of the Belasco Theatre, New York

In This Issue

	Page
Six Greatest Engineering Feats. *Selected by Ralph Modjeski*	25
Wonders at Your Doorstep	28
He Sees by Radio. *By Norman C. McLoud*	30
The Secret of the Giants. *By Prescott Lecky*	31
Science Purifies Your Drinking Water	33
THE POPULAR SCIENCE INSTITUTE OF STANDARDS. *Announcing a new service*	34
Driving the Store to Your Door. *By Lynn B. Dudley*	36
A Poor Man's $250,000 Gift to Science. *By W. D. Thomson*	37
New Discoveries in Science	38
World Fliers Ready for Emergency. *By Corley P. McDarment*	40
Nature's Magic in Radium. *By Raymond J. Brown*	41
Adventures in Home Ownership. *By Phil M. Riley*	44
Automobile Carried by Two	46
Apartment Mailbox	46
A Mechanical Traffic Cop	46
Shoe Rack Attached to Closet Door	47
Smallest Coupé on Bicycle Wheels	47
Chimney Salvaged by Angle Irons	47
Metal Strip Alines Typist's Paper	48
Powerful Headlight in Two Colors	48
Odd Designs from Cancelled Stamps	48
One-Man Dragsaw Fells Trees	49
Screwdrivers and Hammer in One	49
Elastic Roadside Fence	50
Burglar Protector for Door Lock	50
Tunnel Building Under the Hudson	51
Truck, Tractor, and Crane Combined	51
Lather Gun Replaces Shaving Brush	51
Lumber for a House in One Log	52
A Powerful New Pipe Wrench	52
Machine Makes Butter in 30 Minutes	52
Tides Used to Move Old Bridge	53
Cold Sealing-Wax Squeezed from Tube	53
Improved Bicycle Brake	53
New Inventions for the Household	54
Marine Pests Bore into Piling	56
An Odd Tree-Climbing Fish	56
Giant Rivals of the Potato	56
Powerful Beacons to Guide Aviators	57
Machine Talks with Electric Voice	57
Workmen's Efficiency Analyzed	57
Unsinkable Canoe for the Camper	58
Airplane Propeller Drives Motor-Car	58
The World's Official Clock	58
Hudson Maxim Still Young at 71	59
Electricity for Edison's Birthplace	59
Midget Engine Drives Model	59
Life Raft Serves as Duck Blind	60
Automatic Landing Net for Fishermen	60
Spruce Limb as Weather Prophet	60
Garden Tool Performs Three Tasks	61
Sailor Makes the Wind Saw Wood	61
New Tool for Opening Wrappers	61
The World's Greatest Powder Blast	62
Monoplane like Helicopter	62
"Crawlers" to Double Tractor's Pull	63
Fishing Engine Pulls in the Big Ones	63
Divers Telephone from the Depths	63
Excavator Walks 30 Feet a Minute	64
How Much Science Do You Know?	64
A Light Cultivator for the Garden	64
Walking Radio Receiver	65
Safeguarding the Morning Milk	65
Automatic Secretary Records Calls	65
Your Garden in the Summer. *By Ernest Bade, Ph.D.*	66
An Ideal Portable Radio Receiver. *By Joseph Calcaterra*	68
Radio by the Roadside. *By Jack Binns*	69
America's Fastest Growing Sport. *By Leslie V. Spencer, M.E.*	71
When Your Car Is Stuck in the Mud	72
New Ideas for the Folding Camp	73
Repair Kinks for Motorists	74
The Home Workshop	**75**
Better Shop Methods	**80**

And other timely articles and pictures

POPULAR SCIENCE MONTHLY

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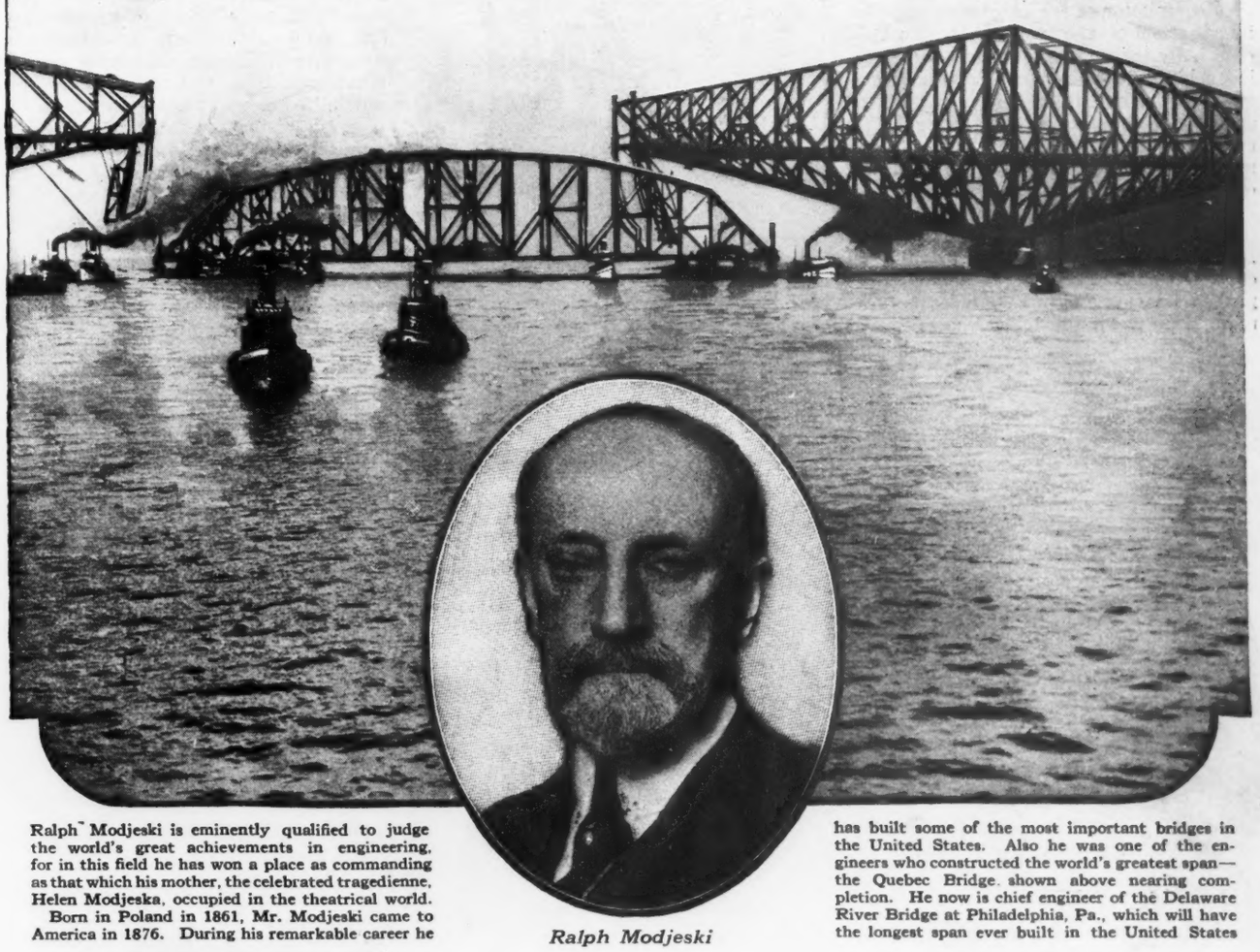
POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
June, 1924



Ralph Modjeski is eminently qualified to judge the world's great achievements in engineering, for in this field he has won a place as commanding as that which his mother, the celebrated tragedienne, Helen Modjeska, occupied in the theatrical world.

Born in Poland in 1861, Mr. Modjeski came to America in 1876. During his remarkable career he has built some of the most important bridges in the United States. Also he was one of the engineers who constructed the world's greatest span—the Quebec Bridge, shown above nearing completion. He now is chief engineer of the Delaware River Bridge at Philadelphia, Pa., which will have the longest span ever built in the United States

Ralph Modjeski

Six Greatest Engineering Feats

Selected by Ralph Modjeski

ATTEMPTING to select the six greatest engineering achievements of modern times is like trying to name the six greatest men of history. Any list one might make is bound to be merely a reflection of personal opinion, which is quite likely to be influenced by prejudice or individual standards of judgment.

Ten, twenty, probably a hundred times that number of undertakings that have been completed by engineering science during the course of my life must be called great because of their vastness, their difficulty, or the benefits they have brought to mankind.

The last half century has seen engineering keep pace in many parts of the world with the progress made in other branches of science. Bridges, canals, power and irrigation projects, roads, docks, waterworks, tunnels, cuts, and other features of railway construction, subways and skyscrapers have followed one another with bewildering rapidity, each new work surpassing in magnitude, cost, and daring those that preceded it.

That is why neither size, cost difficulties surmounted, nor even benefits accruing to man, supply an infallible measure of the "greatness" of engineering projects. One must take into consideration also the time at which the undertaking was prosecuted. For in engineering, things that were "impossible" or exceedingly difficult 50 years ago, or even 20 years ago, are accomplished as a matter of course today by means of improved machinery and increased skill and knowledge.

And so, if I am to select the six engineering works that, in my opinion, are the greatest that have been accomplished in modern times, I must include those that were highly remarkable at the time they were completed, even though subsequently they have been surpassed. The six are, in order of time:

THE Suez Canal
The Firth of Forth Bridge, near Edinburgh, Scotland
The Assuan Dam in Egypt
The Panama Canal
The Roosevelt Dam in Arizona
The Quebec Bridge over the St. Lawrence River.

I cannot say truthfully that I remember the construction of the Suez Canal, for it was begun April 25, 1859, two years before I was born. I do, however, remember its formal opening on November 25, 1869. Few events that I can recall aroused such tremendous enthusiasm as the passage through the canal on the following day of 56 vessels, headed by the French Imperial yacht *L'Aigle* carrying the Empress Eugénie.

THERE was scant wonder that the completion of the canal captured the imagination of the world. It was undoubtedly the most stupendous engineering achievement the people of that time had known, and it had been carried to success in the face of harrowing difficulties—natural, financial, and those reared at the outset by adverse public opinion.

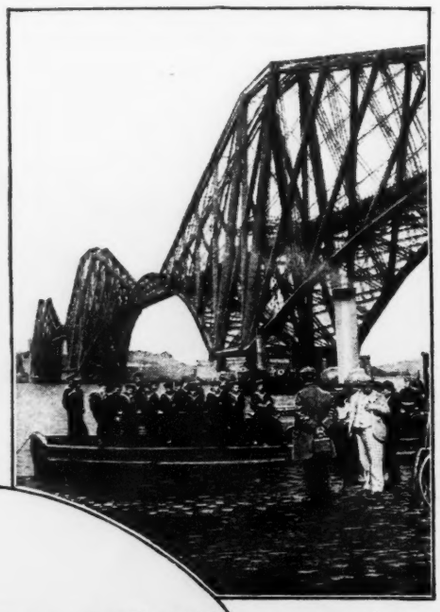
It was a project as old as history, for archeologists say that Seti, father of Rameses the Great, in the fourteenth century before Christ, began a canal and pushed its construction 60 miles before relinquishing his plan. Almost every ruler of Egypt from that time to the days of Napoleon Bonaparte had considered the possibility of digging a canal through the Isthmus of Suez.

It remained for Ferdinand de Lesseps, a young Frenchman, to obtain the necessary concessions and to raise sufficient funds to undertake construction.

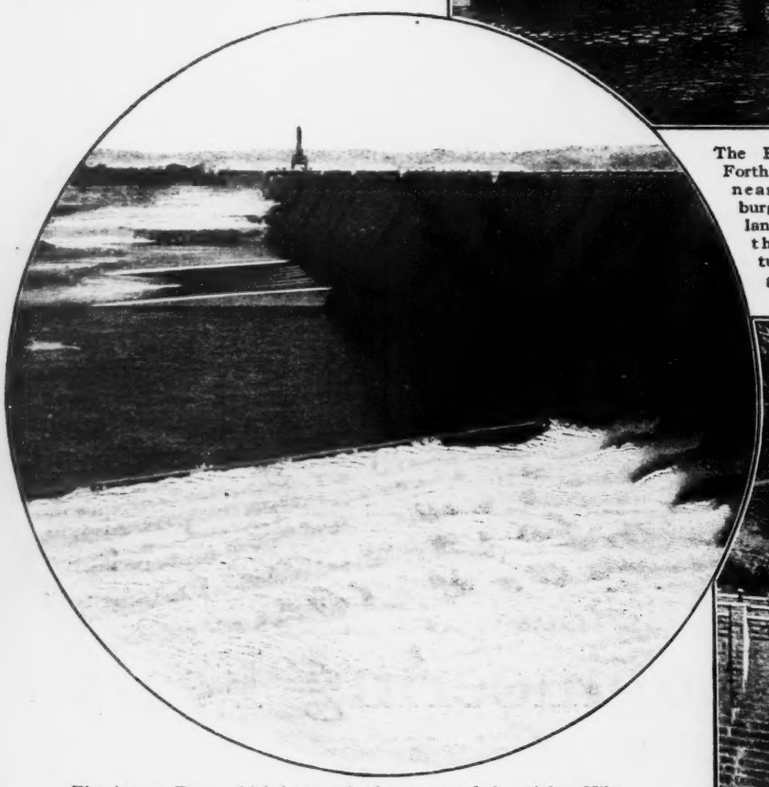
Some idea of the difficulties that confronted de Lesseps may be obtained from the fact that the newspapers of 1858 called his attempt to finance the canal project a "swindle," and that he was unable to obtain funds in the United States, England, or Russia. All of his original capital of 200,000,000 francs was subscribed in France, Turkey, and Egypt.

The Suez Canal extends from Port Said, where construction began, to Suez. It is 100 miles long; yet by connecting the Mediterranean with the Red Sea, it brings the Occident 10,000 miles closer to the Orient—a great commercial advantage.

As originally constructed, the canal's depth averaged about 25 feet. It was about 75 feet wide at the bottom, and its breadth at the waterline ranged from about 160 feet to a little more than 300 feet. Vessels could pass one another only at certain crossing places. In 1876, though, the work of improving the channel was begun. This work has continued up to the present day and now the channel, in every dimension save the length, is virtually twice as large as when first constructed. Once it required 36 hours for a vessel to pass through. Now passage is effected in less than half that time.



The Firth of Forth Bridge, near Edinburgh, Scotland. Note the huge tubular girders

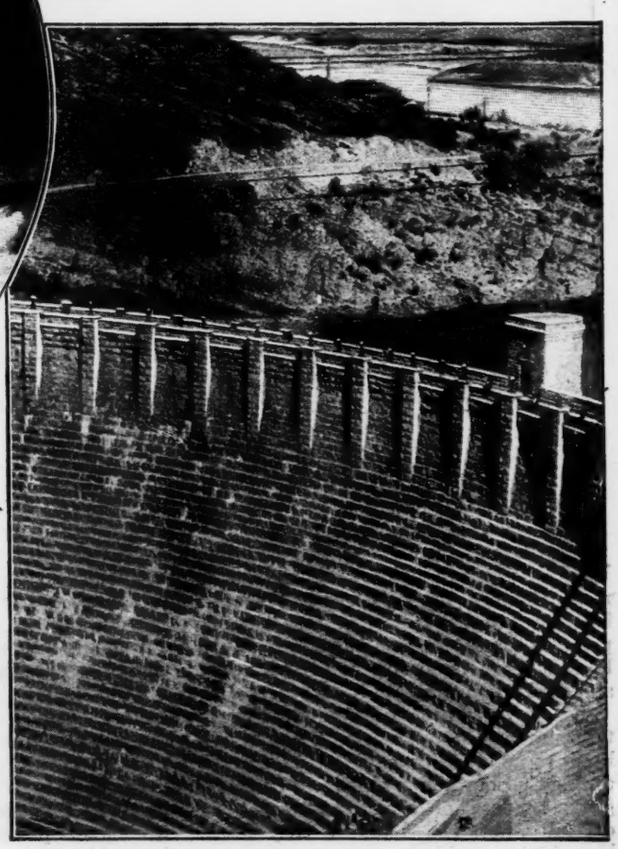


The Assuan Dam, which impounds the waters of the mighty Nile, irrigating the Valley of the Nile in Egypt for a total distance of 700 miles. Built 22 years ago, this great engineering structure still remains the largest project of its kind ever undertaken

TO DIG a Suez Canal today would be a relatively simple task. Modern engineering skill and machinery probably would shorten by half the time required for construction. But the builders of the Suez Canal were forced to acquire their own skill and their own experience and to develop their own machinery as they went along. They were pathfinders. They contributed a great achievement to engineering history and a mighty aid to commerce, and marked a new era in the world's progress. That is why I must call the building of the Suez Canal one of the greatest feats of engineering in the history of the world.

To those who would say that the Panama Canal is a greater monument to engineering skill than its predecessor across the Isthmus of Suez, I can only reply that the Panama Canal undoubtedly is the most tremendous engineering achievement of all time. It does for the New World what the Suez Canal did for the Old—unites the East and the West, though on a scale vastly more lavish.

In fact, the Panama Canal was an undertaking of such heroic proportions that the result is more than an engineering achievement. It is one of the new wonders of the world. But it was completed almost a half century after the Suez Canal was built, and in the interim the science



The Roosevelt Dam, completed in 1911, in Salt River Valley, near Phoenix, Ariz. Located at the mouth of a canyon, it is a huge quarter circle of sandstone and cement, 280 feet high and 168 feet thick at the base, most impressive, and surmounted by a 16-foot roadway. It is exceeded in size only by the Assuan Dam

of engineering had made such giant strides that the problems of its builders were enormously simplified in comparison.

It supplies the most striking illustration we have of the progress that was made in engineering in the nineteenth century, for de Lesseps, builder of the Suez Canal, attempted to construct a Panama Canal following his first triumph and spent $300,000,000, only to score the most colossal failure in the history of engineering.

The Right Hon. James Bryce, later British Ambassador to the United States, called the Panama Canal "the greatest liberty man ever took with Nature." I cannot hope to add anything to that statement.

THIRTEEN years after the completion of the Suez Canal there was begun in Scotland the greatest project in bridge construction that man ever had attempted—the Firth of Forth Bridge. A vivid idea of the immensity of this structure is given by the statement of Sir Benjamin Baker, its builder, that it compared in size with the largest bridge previously built in Great Britain as a Grenadier Guardsman compared with a newborn child.

From bank to bank at the site of the bridge the Firth of Forth measures 8091 feet—more than 1½ miles. Foundations for the viaduct approaches had to be sunk in water almost 200 feet deep, a tremendous detail in itself. The bridge is of the cantilever and central girder type and, but for the fact that the central cantilever could be placed partly on the Island of Inchgarvie, which stands about halfway across the Firth, it is unlikely that construction would have been possible. And yet, even with this aid supplied by Nature, the two main spans each are 1700 feet long—almost a third of a mile. These were the longest spans built anywhere in the world until the Quebec Bridge was constructed, more than a quarter of a century later.

The Firth of Forth Bridge was completed late in 1889, and formally opened by the Prince of Wales, afterward King Edward VII, on March 4, 1890. The huge tubular girders used in its construction give to it a peculiar appearance of stability that is borne out by the service it has given through almost 35 years.

The bridge has a clearance of 157 feet above high water and its central tower rises 150 feet higher. Marked ingenuity was used in its construction. The rolled material for the structure was taken to the site and fitted into place piece by piece as a steel ship would be built, thus obviating the necessity for heavy machinery and lifting apparatus to place the materials.

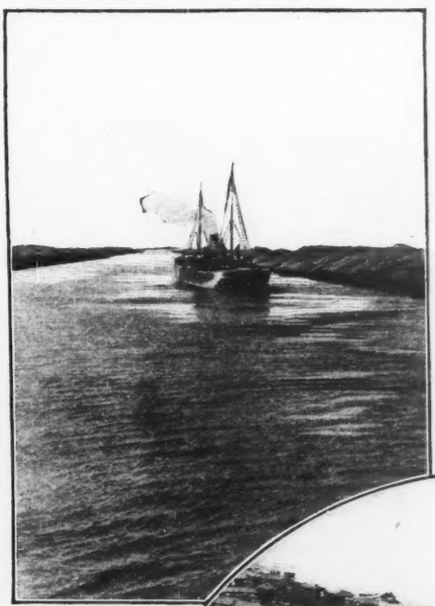
As a feat of engineering, the construction of a bridge like this would be noteworthy, even at the present day. At the time it was built it marked an epochal advance in engineering.

THAT the Quebec Bridge, which crosses the St. Lawrence River in Canada, is more massive and has a clear span 100 feet longer than that of the Forth Bridge in no wise detracts from the glory won by the builders of the great structure in Scotland. For the Quebec Bridge was completed almost 30 years after the Forth Bridge, and, as in the case of the Suez Canal and the Panama Canal, engineering skill and knowledge had advanced with the intervening years.

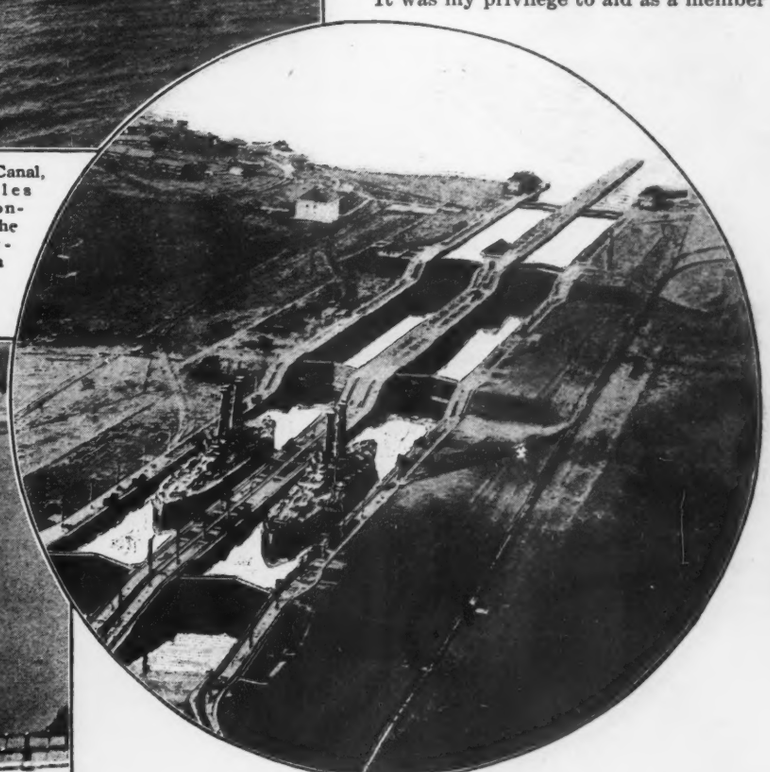
It was my privilege to aid as a member of the board of engineers in the construction of this greatest bridge of recent years, which was completed in 1917. Its center span of 1800 feet still is the longest ever built. It is the heaviest, too, for, owing to the increase in size and weight of locomotives and railway cars, it was necessary to build the Quebec Bridge strong enough to withstand a stress 2¼ times greater than that which can be borne by the Forth Bridge.

It is interesting that Sir Benjamin Baker, besides contributing the Firth of Forth Bridge, was associated eight years

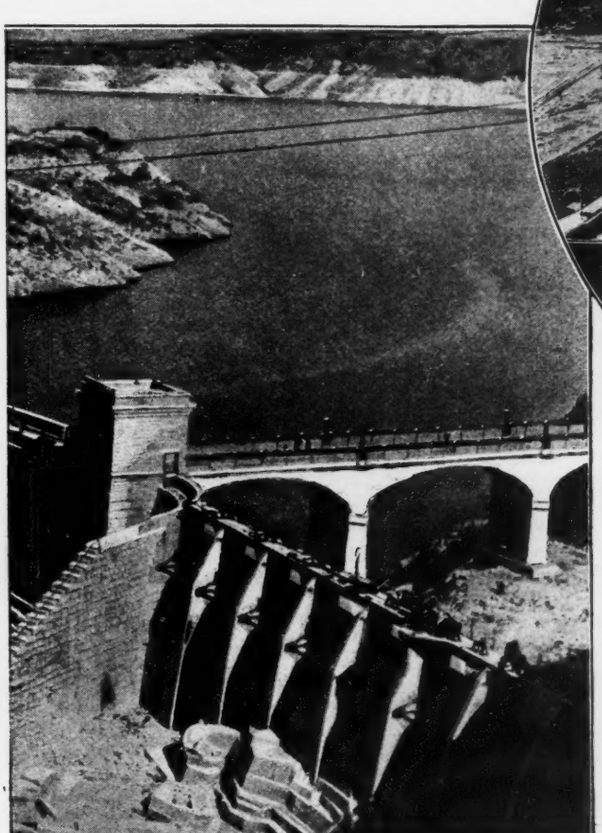
(*Continued on page 126*)



The Suez Canal, 100 miles long, connecting the Mediterranean and the Red Sea

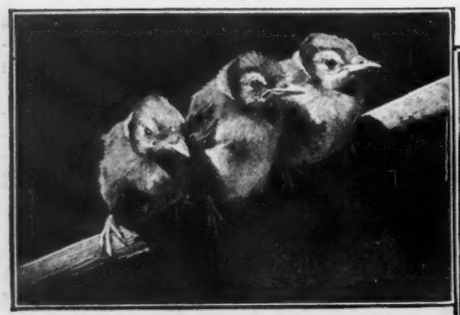


Enormous locks of the Panama Canal, showing the U. S. battleships *Delaware* and *North Dakota* floating abreast in the great waterway that Mr. Modjeski calls the most tremendous engineering achievement of all time—one of the new wonders of the world

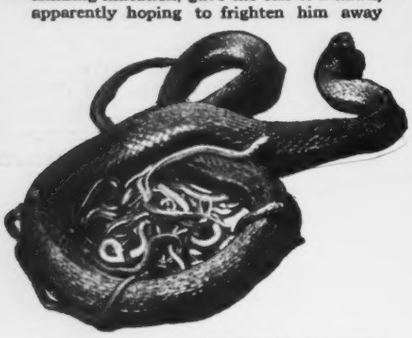


The Roosevelt Dam is designed to store the flood waters of Salt River and Tonto Creek for the irrigation of 240,000 acres of land in Salt River Valley. The reservoir has a capacity of 1,284,000 acre feet, enough water to cover the state of Delaware to a depth of one foot. It has made vast wastes available for farming

Wonders *at Your* Doorstep

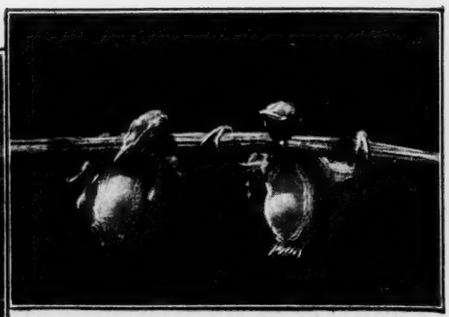


Three baby Blue Jays. When Doctor Pardoe took this picture, the parent bird, with amazing imitation, gave the call of a hawk, apparently hoping to frighten him away

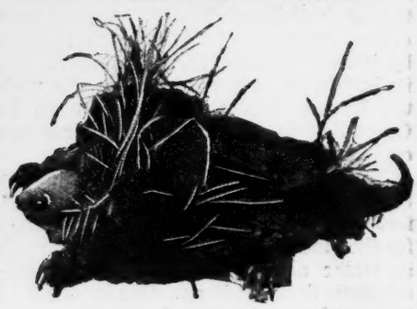


A common Garter Snake with 57 young, one day old. Some snakes lay eggs, while others, like this one, bring their young into the world alive, the former being called "oviparous" and the latter "viviparous"

Dr. Jonathan B. Pardoe, during a jaunt, making friends with baby High-Holders



Baby High-Holders, holding on high. The grown birds are skilful carpenters, drilling their homes in decayed trees. They are known also as Golden-Winged Woodpeckers



Here is a common Snapping Turtle that has skilfully camouflaged itself with mud and grass as a protection against its enemies. This is just one of many strange sights Doctor Pardoe encounters in his walks

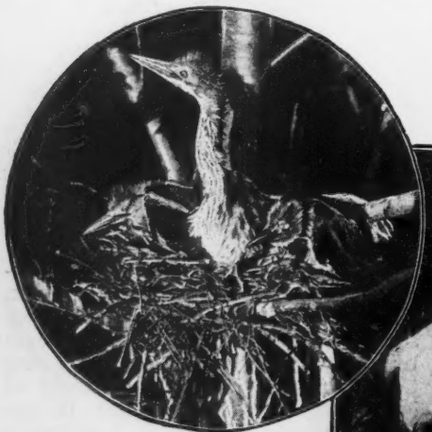
SOME of us travel thousands of miles and spend small fortunes in search of the world's thrills and wonders. Yet others have learned to find never-ending adventures right at their own doorstep or in near-by fields and woods, where they are forever discovering new marvels of nature in things that most of us pass by as commonplace.

Such a person is Dr. Jonathan B. Pardoe, of Bound Brook, N. J., a dentist by profession and a naturalist by hobby. Since he was a barefoot boy of 10, with a camera and a Gordon setter, he has spent every spare moment roaming the fields and woods, watching the exciting daily events in the busy world of beast, bird, and insect, and recording these events in remarkable photographs.

He has felt the teeth of an angered opossum. He has watched the courageous king bird battle to victory against the mighty hawk. He has spied upon the timid wren, entering her nest in the end of a hollow tree limb. He has come upon a deadly rattler swallowing a brother snake. He has seen how a mother garter snake cares for her 57 young. He has helped a beleaguered land turtle to rid itself of a seething army of black ants; and he has been surprised by a snapping turtle oddly camouflaged with mud and grass against its enemies.

Doctor Pardoe has found, too, that birds make ideal pets. Four baby owls that he brought home from one of his jaunts became so tame that they would perch on his shoulder! Likewise he tamed a young crow that became the inseparable friend of his dog and would ride around on the dog's back, joining the chase for squirrel or rabbit.

All these adventures, and many more like them, Doctor Pardoe has preserved in photographs, some of which are reproduced here. He says any one of us can find things just as interesting.



A young Green Heron on its nest. The Heron builds in colonies commonly known as rookeries. Its home, usually near a pond or river, is constructed of a few sticks loosely woven together, located about 25 feet from the ground. Its food consists mainly of small fishes, tadpoles, and snails

"Jack and Jill." Jill, the crow that Doctor Pardoe raised and tamed from babyhood, became the inseparable companion of Jack, his dog

Jenny Wren, with a spider in her bill, about to enter her nest in the end of a hollow limb. Many days of patient waiting were required to make this remarkable snapshot. The little bird also fed her young with grasshoppers, caterpillars, moths, and larvae of different and tempting kinds

Discovered *by a* Cameraman

These three baby Screech Owls were brought home by Doctor Pardoe from one of his jaunts. After he had tamed them, he perched them on an old straw hat, attracted their attention with a butterfly moth, and snapped the picture

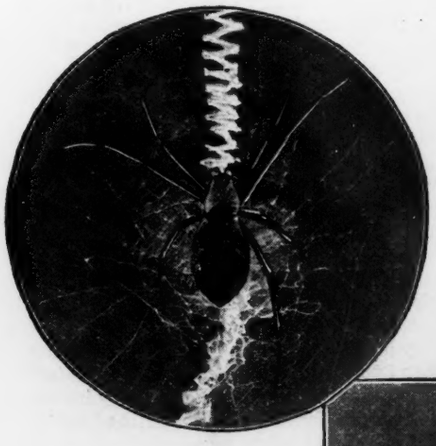
A large Snapping Turtle hanging by its jaw. The turtles usually are found in muddy streams. Often they catch young ducks by pulling them under water, drowning them

Mr. Opossum looking out of the door of his home. The trick that has made him famous is to "play dead" when attacked. He generally is believed to be dull-witted, but at times he is surprisingly agile. Doctor Pardoe declares he is superior to a cat in his skill as a rat-catcher

Tree Frogs, sunning themselves on their "front porches." As their name implies, they live in trees, and they have the power of sticking to almost any surface with their feet. Usually they give their calls at night, and especially when rain is threatening

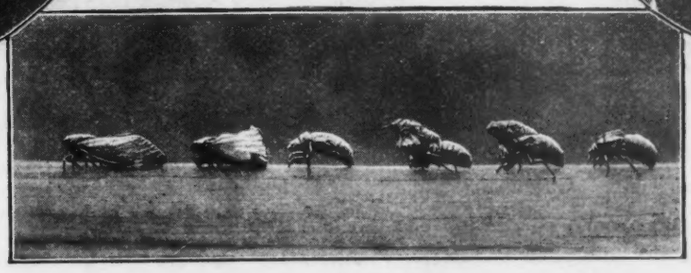
Here is a Fish Hawk hovering above its nest at the top of an electric light pole. Usually this great bird builds its nest in a tall tree, but in some instances has been known to build on rocks a few feet from the ground

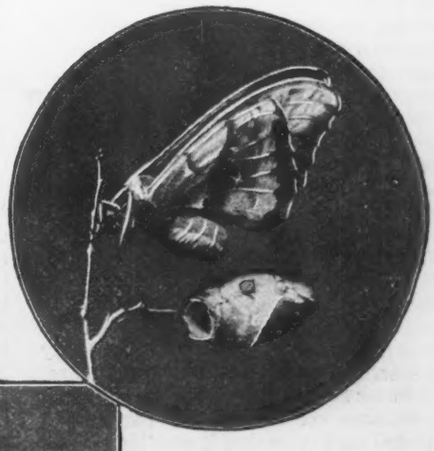
A Screech Owl and its young. Doctor Pardoe found these birds very easy to tame. One evening, while sitting in his study with the window open, he called. In reply, his pet owls flew through the window and perched on his shoulder, where they sat, blinking solemnly



The Garden, or Ladder Spider, on its web. It is known also as the River Spider. Usually it builds its web along river banks in the tall grasses. The name Ladder Spider is derived from the sturdy, ladder-like structure that it spins across the center of the silken web

The remarkable photograph below shows six stages in the development of the Cicada, or Seventeen-Year Locust. After a prolonged existence underground, the pupa (at the extreme right) emerges and sets free the perfect winged insect through a slit in the thorax, as shown



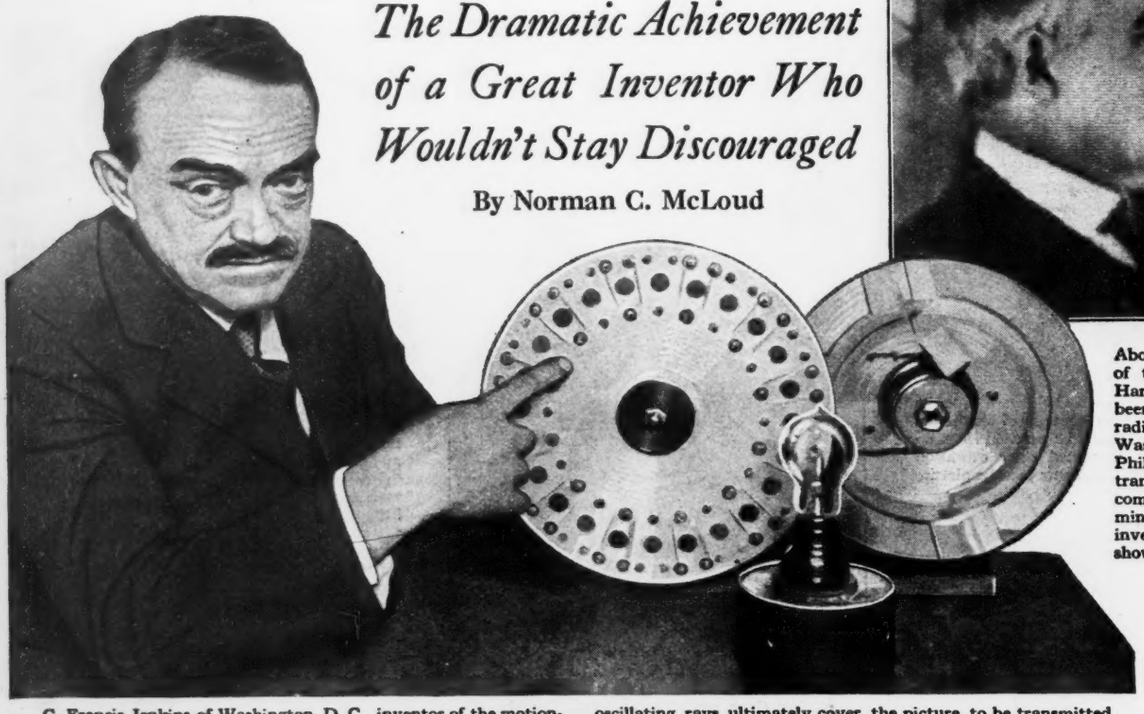


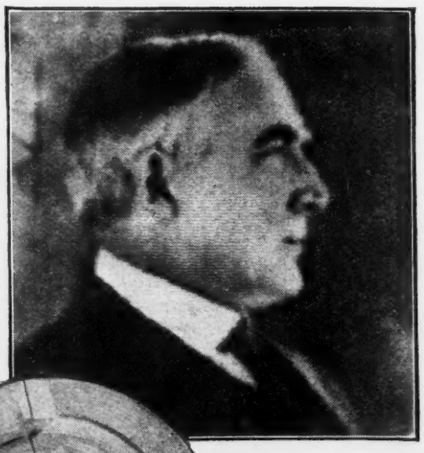
Above is a magnificent Polephemus Moth, just emerged from its cocoon. The cocoon often is found on young white-birch trees. When warm weather comes, the moth emerges by eating a hole in the top. Its folded wings soon dry and spread in a colorful display

He Sees by Radio

The Dramatic Achievement of a Great Inventor Who Wouldn't Stay Discouraged

By Norman C. McLoud





Above is a photograph of the late President Harding after it had been transmitted by radio 135 miles from Washington, D. C., to Philadelphia, Pa. The transmission was accomplished in three minutes by the newly invented apparatus shown at the left

C. Francis Jenkins of Washington, D. C., inventor of the motion-picture projector, demonstrating his latest achievement—an apparatus for transmitting pictures by radio. In transmission, a pencil ray of light passes through rotating glass disks of graduated thickness, which bend the rays and cause them to oscillate. These oscillating rays ultimately cover the picture to be transmitted, and are modulated. The modulated waves then strike a light-sensitive photo-electric cell, and are transformed into radio waves of corresponding variation. The radio impulses thus transmitted are reconverted into light waves by a machine

IN A laboratory in Washington, D. C., a few weeks ago, I had the extraordinary and positively uncanny experience of talking face to face with a man who was actually in a room at another end of the building. His voice came to me over the radiophone, but for a few seconds I saw him in life size and full detail on the white wall in front of me.

No spiritualist's séance could have produced an effect more weird than this of seeing a man whom I knew to be half a hundred feet away from me and screened from my sight by substantial walls. And yet I knew that in reality there was nothing mysterious about it. Only a few minutes earlier the man whose ghostly image looked down on me from the wall had explained to me exactly how he was able to project himself through solid woodwork and plaster. For the amazing thing I was witnessing was merely a demonstration of a new wonder of science—radiovision, developed by C. Francis Jenkins.

This invention is not a method of transmitting moving-pictures by radio. Although it makes the transmission of movies possible, the camera is not used. Rather, what Jenkins has devised may be described as a sort of supertelescope, one whose field of vision is neither dimmed by distance nor obscured by barriers; a contrivance that makes it possible to view far-away events the instant they take place, just as the radio permits us to hear distant sounds as they occur.

The apparatus still is in the experimental stage. Jenkins does not claim perfection for it yet. But so confident is he of success in the near future that he already is planning a dramatic public demonstration. He intends to have a deaf-and-dumb man in Boston hold a conversation in the sign language with a deaf-and-dumb man in Washington, thus giving to the deaf mutes their first telephone. After that, he says, it will be only a short time until sporting events and other public spectacles will be broadcast for the eye, precisely as descriptions of them now are broadcast for the ear.

No doubt you are more or less familiar with the name of C. Francis Jenkins, but you probably do not know that he holds an indisputable right to be numbered among America's great inventors. It was he who invented the moving-picture projecting machine 30 years ago, thereby changing the movies from a child's toy into an instrument of vast commercial, artistic, scientific, and educational value.

THIS invention brought Jenkins very little fame, and no money at all. In fact, his experiments plunged him into debt. The world of science, however, has accorded him recognition. He bears the unusual distinction of having been honored twice by the Franklin Institute of Philadelphia for his invention. One of his choicest possessions is a letter from Alexander Graham Bell, inventor of the telephone, praising him for his early motion-picture projecting machine. But fate played a strange prank in denying to Jenkins recognition from the public, to whom undoubtedly moving pictures have meant most.

Jenkins, though, has accepted this fact with a complacency that is characteristic.

"My projecting machine," he told me, "represented more than four years of persistent effort. When I first demonstrated it in 1894, there was not another device like it in the world. After the publication of the *details* of my method two years later, machines of the same kind sprang up like mushrooms, and within 20 months three times as many patents for moving-picture apparatus were issued as had been granted in the 30 years preceding.

"WHEN I realized that my invention was going to pay me only in self-satisfaction, I did what many people would regard as a strange thing. At the time I was secretary to Sumner I. Kimball, executive head of the United States Life-Saving Service. My salary was $1600 a year; good pay in those days. But I gave up my job to devote my entire time to invention. I was determined to make a go of invention or starve trying. Well, I haven't starved, neither have I been cured of the inventing habit."

"So you must have made a go of it?" I suggested.

"That depends on how you look at it," said Jenkins. "I have some wealthy friends who are frankly sorry for me because I haven't made as much money as they have. However, I've taken out more than 300 patents, I've had plenty of interesting experiences, and some of my inventions probably have lightened the burden of some of my fellow men.

"Most of my inventions were pot-boilers—things I sold for from $250 to $2500 to give me a living and pay for the greater things I had in mind. A motor-driven lawnmower, an automobile tire chain, and a check protector probably are typical.

(*Continued on page 128*)

The Secret of the Giants

Strange New Facts about Glands—Tiny Drug-Stores of Your Body

By Prescott Lecky

Department of Psychology, Columbia University

A GIANT from the backwoods, arriving in Hollywood recently to begin his career as a motion-picture actor, furnished the newspapers with a sure-fire humorous story that set the nation grinning. For the giant, in order to accommodate his architecture to the limitations of a Ford car, had cut a hole in the top and protruded his head and neck through the aperture! No doubt we shall see him in slapstick comedy before long; and whether he is a comedian or not, undoubtedly he will succeed in entertaining us. He is a giant, and that is enough.

Giants have been a source of wonder since the dawn of history. We think of the giant as a superman, which is only one step removed from thinking of him as supernatural. Somehow he seems inexplicable in natural terms.

But now the mystery of the giants is going the way of other mysteries; for science has found the key to gigantism.

The key lies in a few bits of tissue so small that they can be held in the hollow of your hand, yet so important that they even may unlock the innermost secrets of the processes of life and death. Scattered about the body—in the head, neck, and trunk—these unimportant-looking little granular masses in reality are tiny chemical laboratories—a whole chain of bodily drug-stores, dispensing wonder-working remedies of their own manufacture.

The world's smallest bellhop, Dee McLain, is seen showing John Aason, Los Angeles giant, to his room in a New York hotel. Each man is just 24 years old, but John is a little more than eight feet tall, while Dee measures just three feet. Science now believes that the giant and midget are the result of overdevelopment and underdevelopment of the pituitary gland, an insignificant-looking lump of tissue

SO NEW are they to the scientific world that they still are known by three different names—"endocrin organs," "ductless glands," and "the glands of internal secretion." They empty their secretions directly into the blood vessels that nourish them, and so are distinguished from the so-called duct glands, which pour out their secretions through tubes or ducts and deposit them upon either the inner or outer surfaces of the body.

The important ductless glands are the pituitary, pineal, thyroid, adrenal, gonads, thymus, and the island cells of the pancreas. The wonder-working remedies they secrete are known by two names—"autocoids," meaning "self-drugs"; and "hormones," meaning to arouse or stir up. They act as body accelerators, and sometimes as body brakes. The power of their action on the body passes belief.

Through the discovery of the locations and functions of certain of these body chemical laboratories, great research laboratories are writing a new and marvelous drama of science.

It is a tale not only of giants, but of midgets as well; also of fat ladies and human skeletons. And it goes even further, concerning itself vitally even with the water you drink, the food you eat, and the medicine your doctor may subscribe. You have seen in the papers recently that large cities are considering the matter of putting iodin into the city water. That is part of the story. So is the recent advice of the United States Bureau of Fisheries that you should eat more salt fish. So is the discovery of insulin, the wonderful remedy for diabetes, by Dr. Frederick Grant Banting, of Toronto, Canada.

In short, the drama of life that science is unfolding in a few small glands promises to become, when completed, the most important body of information, from a human standpoint, yet discovered.

Consider, for example, the single item of insulin—one of the autocoids, or chemical secretions, which Doctor Banting extracted from certain glandular cells of the pancreas. In the few short months since its discovery, practically every other diabetes remedy on the market, along with much of the old-fashioned medical procedure, has been thrown into the discard. What does this mean for the future? What will be the fate of our concoctions and patent medicines in use today? What will drug-stores carry on their shelves 20 years from now?

MUCH of the evidence concerning the functions of the ductless glands has been obtained experimentally by administering to the human body secretions taken from the glands of animals. In some cases an entire gland has been grafted into the body. Other evidences come from clinical cases in which over- or under-secretion of the glands can be demonstrated.

These observations and experiments offer a basis for believing that before long it may be possible to grow giants experimentally (provided, of course, any one wished to be a giant!), just as botanists grow giant plants. Note the word *possible*. This experiment never has been attempted on a human being, and probably never will be. But even with the elementary knowledge and technique now available, such experiments performed upon dogs and other animals have shown some measure of success.

Perhaps our children or grandchildren may see dogs as large as horses produced by this means. This, too, is speculation; but remember that lizards grew to be 50-foot dinosaurs.

One of the main sources of such scientific romancing is the pituitary gland, an insignificant-looking button of tissue, somewhat smaller than the end bone of your little finger, known as "the gland of the giants." It is situated just back of the root of the nose in a bony socket of its own—a skull within a skull.

Few if any parts of the body are so carefully fortified against accident and injury, and with good reason, for its removal invariably causes death. The gland consists of two lobes, an anterior, or front lobe, and a posterior or back lobe.

Each has a different function. Now the anterior lobe of the pituitary, small as it is, seems to dominate the bony growth in the body and regulate the size of the skeleton. An oversecretion of this lobe causes the bones to grow with astonishing rapidity, and this is the cause of gigantism. An undersecretion, on the other hand, prevents the growth of bone and results in one form of dwarfism.

Many lines of evidence lead to this conclusion. In the first place, in the few dwarfs who have been available for X-ray study, the pituitary was found to be exceedingly small and wasted. Studies of giants, on the other hand, have shown invariably an abnormally large pituitary.

The most convincing evidence, however, is to be found in actual clinical cases where excessive pituitary secretion from natural causes can be demonstrated. The story of John Turner, reported by Dr. Harvey Cushing of Harvard, is a typical example.

At the age of 15, John Turner began to grow rapidly. He developed a tremendous appetite, and is said to have taken a pint of whisky regularly for breakfast. He shot up to a height of eight feet three inches. When he went to a hospital at the age of 36, suffering from an overgrowth of the knee joints, his weight was found to be 275 pounds, in spite of extreme emaciation.

His hands and feet were enormous. He wore a child's undershirt for a sock, and his shoes were 15 inches long. The bones of the face were so overdeveloped that the ears were located far to the rear of the head. The brain was weighed after death and found to be of gigantic proportions, weighing 4 pounds, 2½ ounces, or 1884 grams, believed to be the largest on record. (The average brain weight is 1400 grams.)

EXAMINATION showed the pituitary enlarged to several times the normal size. When the pituitary begins to oversecrete in later life, the bones thicken but do not lengthen.

This example represents abnormal extremes, but there are many normal men of the pituitary type who share the same characteristics in lesser degree. Such men have large bones with heavy joints, especially noticeable in the hands and feet. The teeth also are large, and the nose, jaws, and other features prominent. Often the arms and legs are hairy.

Unless offset by abnormalities in other glands, a large, well-nourished brain is another pituitary characteristic, so much so that the pituitary has been called the gland of intelligence. Lincoln is a good instance of the normal pituitary type.

Other glands influence growth also, though indirectly. Moreover, all the glands work together, retarding or accelerating one another, as the case may be, and the total result is a compromise or balance.

That is why the research work goes forward so slowly. It is also a good thing to bear in mind when you read advertisements offering various gland extracts as fat-reducers, "pep-makers," etc. Most drugs are like popguns—they make their little noise and not much happens. But endocrin extracts are heavy artillery, and the amateur will do well to leave the bombardment to experts.

Thus, in spite of the Chinese wall that nature has built around them, the secrets of the pituitary are slowly being solved, even though as yet we have caught only a glimpse of their wonders. As experimental work accumulates, the evidence grows more convincing. If we are indeed approaching a new era in medicine it well may be called the age of the endocrins.

"More and more," says Dr. L. F. Barker of Johns Hopkins, "are we forced to realize that the general form and external appearance of the human body depends, to a large extent, upon the functioning, during the early developmental period, of the endocrin glands. Our stature, the kind of faces we have, the length of our arms and legs, the quantity and location of our fat, the amount and distribution of hair on our bodies, the tonicity of our muscles, the sound of our voices, and the size of the larynx, the emotions to which our exterior gives expression—all are to a certain extent conditioned by the productivity of our glands of internal secretion.

The pituitary gland is suspected of other interesting functions. It is believed, for example, to be the agency that preserves in the blood the same proportion of salt that there is in sea water; our original blood, according to the theory of evolution, having been sea water itself. That is why you are urged to eat salt fish. The pituitary, or its forerunner, is present in marine organisms as low as the starfish.

PERSONS in whom the pituitary gland is underdeveloped are characteristically drowsy, with low power of assimilating food, subnormal temperature, slow pulse and insensitivity to pain and emotional stimuli. These also are the characteristics of hibernating animals, and it has been found that the pituitary in such animals gradually shrinks as the period of hibernation approaches, and enlarges when the animal awakens. We are not surprised, therefore, to hear it suggested that the periodic exhaustion of the gland may bear some relation to the enigma of sleep.

It is believed further that the man with a dominant anterior pituitary gland is likely to have a vigorous, commanding personality, whereas the man with a dominant posterior pituitary may be somewhat effeminate.

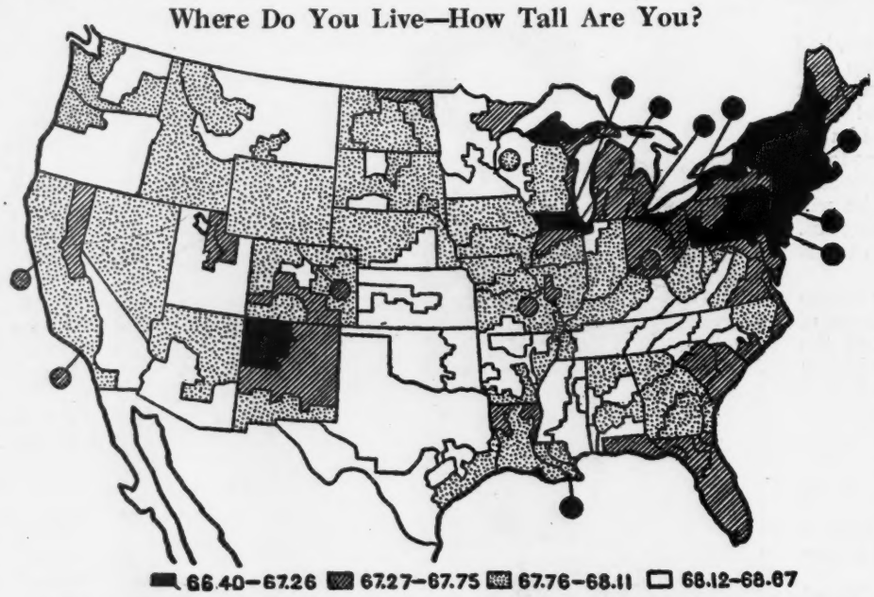
That is by no means certain, but that some connection exists between balance of the glands and personality is undeniable. The nervous system stimulates the glands, and the glands in turn stimulate the nervous system. The theory is growing that insanity itself may have its basis in the glands.

Do you realize what this means? It means that behavior is controlled not only by the nervous system, but also by the blood stream. It means that your "nervousness" may not be wholly a matter of nerves, but partly a matter of your blood chemistry. And it may mean, some day, that a bit of this magic secretion mixed with your food or injected into your arm may change not only your physical appearance, but your disposition as well.

Conceivably, indeed, the salutation of the future may be, "How are your endocrins today?"

NEXT month—The thyroid gland and its functions; how it is believed to affect our physical and mental development.

Where Do You Live—How Tall Are You?

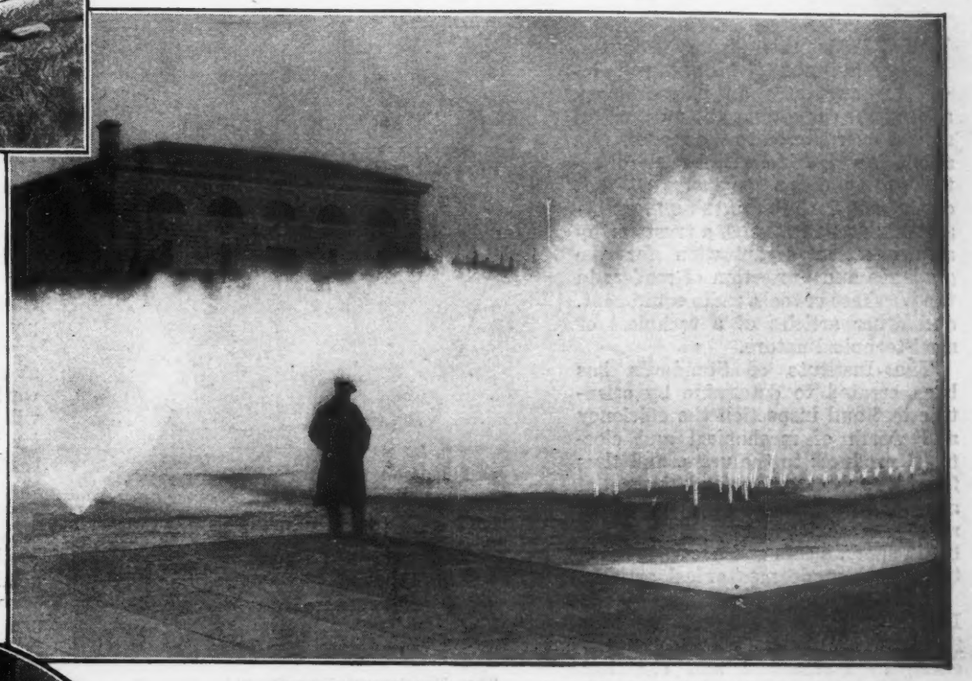


Based on statistics of the war draft, this map shows how man's stature varies in different sections of the United States. The key figures below the map indicate height in inches. If you are five feet seven inches tall, you are an average American in height. North Carolina has the tallest men on the average; Rhode Island the smallest. The stature in rural districts, as a rule, is above that in cities and the tallest populations prevail in the mountain districts of the South and in Arkansas, Kansas, Texas, and Oklahoma. The large black and shaded dots indicate New York, Philadelphia, Boston, Buffalo, Detroit, Chicago, Milwaukee, Cincinnati, St. Paul, St. Louis, New Orleans, Denver, Los Angeles, and San Francisco. Note that all of these cities fall within the classifications of short or medium stature. The map, prepared by Dr. Clark Wissler, of the American Museum of Natural History, would indicate on the whole that, other things being equal, the western and southern populations have the larger pituitary glands than those in other sections of the country, perhaps due to racial differences

How Science Purifies Your Drinking Water

EVERY year homes of the United States consume four thousand billion gallons of water. When you consider that practically every source is subject to pollution, the task of purification becomes vital.

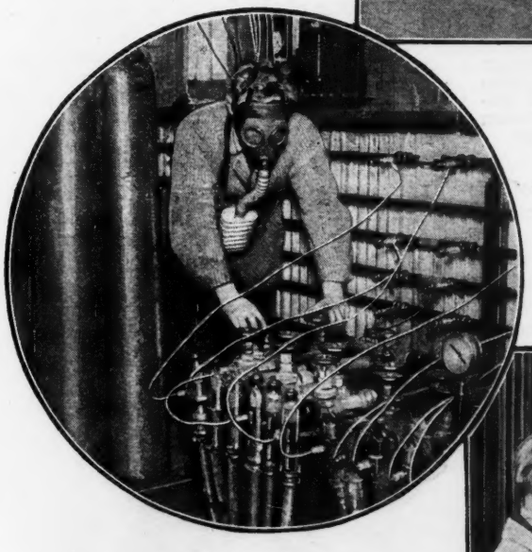
The pictures on this page are typical of improved methods used in purifying the water you drink. In one of these processes, illustrated above, bags filled with copper sulphate crystals are pulled across the reservoir by a boat. The chemical destroys organisms that produce bad tastes and odors, especially in the spring and fall



A SPECTACULAR form of natural purification—the aeration plant at Kensico reservoir, Valhalla, N. Y., typical of a process that helps to safeguard your household from disease. Here the reservoir water, hurled upward, is broken into very small particles.

Thus partially atomized, the water releases many gases imparting taste or odor to the water and absorbed during storage. At the same time, it takes up oxygen from the air, which in itself is an effective disinfectant. Iron present in the water in solution changes form and goes into suspension, after which it is filtered out.

Aeration further breaks up and retards the development of many vegetable organisms that otherwise might taint the drinking water



TODAY 75 per cent of the population of the United States drinks water that has been sterilized by minute quantities of chlorine gas, 25 ounces of which often is sufficient to purify 8,000,000 pounds of polluted water. This form of treatment, while entirely harmless to the consumer, has been found the most effective destroyer of all disease-bearing germs, especially those of typhoid and dysentery.

Above is a view of the chlorination plant at the Catskill aqueduct, N. Y., where gas from liquid chlorine is fed into the water. The operator in charge is protected from chlorine fumes by a gas mask. At six other water-supply stations similar apparatus is used to insure against danger of water-borne diseases.

Of the 525,000,000 gallons of water consumed daily in New York City, 85 per cent is surface water. Of this surface water, 99.8 per cent is sterilized by the very effective chlorine-gas process

IN WATER the presence of considerable quantities of ammonia or nitrogen, either as nitrites or nitrates, indicates sewage pollution. W. A. Horton, a New York City chemist, is shown above demonstrating how free ammonia is distilled from a measured quantity of water under examination

A MUNICIPAL bacteriologist, counting the number of bacteria in a sample of water. In our large cities every precaution is taken that no disease bacteria, especially those that develop within a short time at body temperature, are carried to water consumers. Small samples of water are placed in flat glass trays with culture jelly in which bacteria develop. These trays are incubated at various temperatures. If bacteria are present, they form in colonies that appear as spots. These colonies then are counted

Laboratory Tests to Guide You in Selecting Radio and Tools

Announcing The Popular Science Institute of Standards

WITH this issue POPULAR SCIENCE MONTHLY inaugurates an extraordinary and, at the same time, the most useful service ever offered to the readers of a scientific magazine. Under the direction of eminent engineers it has established THE POPULAR SCIENCE INSTITUTE OF STANDARDS, a trustworthy and effective organization for the guidance and protection of readers in the purchase of tools, radio equipment, and other articles of a technical or semi-technical nature.

The Institute of Standards has been created to determine by scientific test and inspection the efficiency and worth of mechanical and electrical products to the users, and thus furnish authoritative and impartial advice to prospective purchasers with regard to the products tested. It will be, in short, a safe and accurate index to reliably made mechanical articles.

By using the service offered by the Institute, all readers of POPULAR SCIENCE MONTHLY, whether experienced in mechanical and electrical matters or not, will be able to make purchases of tools, radio apparatus, and similar equipment in full confidence that in their purchases they are receiving value for their money and obtaining honestly made goods of merit.

The Institute of Standards, by making approved tests of mechanical and electrical products, performs the double service of pointing out articles that will give service and satisfaction and protecting the readers of POPULAR SCIENCE MONTHLY from the possibility of selecting inferior articles.

No service more useful and more necessary probably could be undertaken at the present time. If you have bought a radio set or radio parts recently, you probably do not need to be told how difficult it is for one who is not an expert to differentiate between high grade products and the inferior products that are manufactured to attract the inexperienced radio enthusiast.

SIMILARLY, large quantities of inferior foreign tools have been unloaded on the American market lately. These tools—automobile wrenches, for example—to the inexpert eye seem exactly like the high grade products of established manufacturers. Indeed, they are frank imitations of good tools—in everything but quality.

Expert advice is the only protection that the ordinary man could have against purchasing these valueless articles, and it is in order that expert advice may be available for all its readers everywhere that POPULAR SCIENCE MONTHLY has established the Institute of Standards.

The Institute of Standards is under the active direction of Professor Collins P. Bliss, Head of the Department of Mechanical Engineering and Director of the Testing Laboratories at New York University. Dr. Hazen G. Tyler, Associate Professor of Mechanical Engineering at New York University, is Associate Director of the Institute. There is available for THE POPULAR SCIENCE INSTITUTE OF STANDARDS staff, more than $300,000 worth of equipment and a fully organized staff of technical experts for the testing of radio apparatus, tools, and similar equipment.

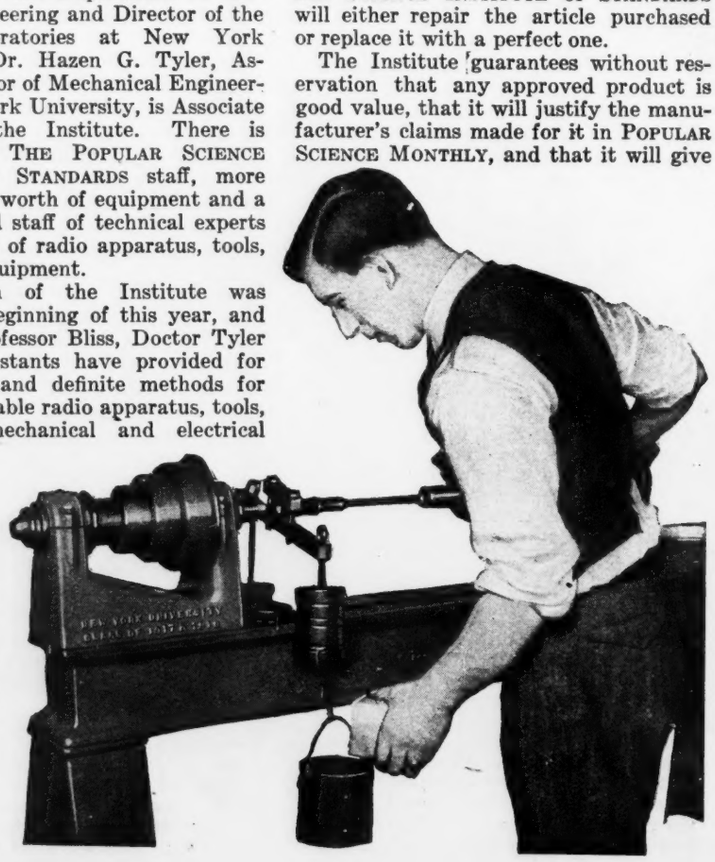
The Director of THE POPULAR SCIENCE INSTITUTE OF STANDARDS—Professor Collins P. Bliss, Head of the Department of Mechanical Engineering and Director of Testing Laboratories, New York University

Organization of the Institute was effected the beginning of this year, and since then Professor Bliss, Doctor Tyler and their assistants have provided for definite tests and definite methods for separating reliable radio apparatus, tools, and other mechanical and electrical equipment from those of questionable worth.

IN ORDER that readers may recognize equipment that has been tested and approved, the Institute issues a seal and a certificate of approval to the manufacturer of an article that has passed the tests. This entitles the manufacturer to display the insignia of the Institute as a token that his product has been approved and is guaranteed to the readers of POPULAR SCIENCE MONTHLY as an article of sound quality, good workmanship and materials, one that will perform satisfactorily the work for which it has been designed, and that meets the claims made for it by the manufacturer in the columns of POPULAR SCIENCE MONTHLY.

Under the guarantee of its seal, the Institute of Standards will adjust any possible dissatisfaction arising between a purchaser and manufacturer because of the failure of an approved article to give satisfaction. Where a product approved by the Institute fails to give satisfactory service, the Institute will take up the matter of adjustment with the manufacturer, and if the manufacturer fails to adjust the matter satisfactorily, THE POPULAR SCIENCE INSTITUTE OF STANDARDS will either repair the article purchased or replace it with a perfect one.

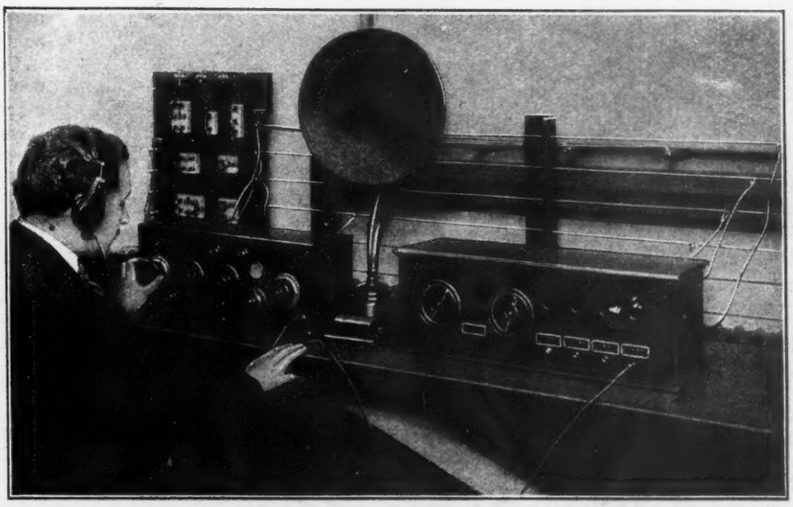
The Institute guarantees without reservation that any approved product is good value, that it will justify the manufacturer's claims made for it in POPULAR SCIENCE MONTHLY, and that it will give



Subjecting a screwdriver to the torsion, or twisting test in the laboratory. The tool is loaded with weights. From these is hung a container into which shot are poured gradually while the increasing twisting of the steel is noted on a scale. It is by tests like this that the Institute can determine whether tools will give satisfactory service

satisfaction under normal and proper use. Checks will be made on the original tests from time to time, and if articles manufactured subsequent to approval prove to be of inferior quality to those first tested, the Institute's approval will be revoked.

The Institute's tests are not conducted with any idea of determining the relative merits of various articles in the same class. If two radio sets, for example, sell for the same price, the Institute of Standards cannot undertake to express an opinion as to which of the two is better. All that the Institute can say with regard to any article is that it is, or is not, of sound value and will, or will not, give satisfaction. In other words, the approval of similar products does not mean that they are necessarily of equal quality or merit, but that for the purposes for which the product is manufactured and sold, as stated in the columns of POPULAR SCIENCE MONTHLY, it will give satisfaction when properly used.



In the radio testing laboratory of the POPULAR SCIENCE INSTITUTE OF STANDARDS. To the inexpert purchaser of a radio set, the sets pictured above would appear to be equal in quality. Yet, when subjected to tests by experts of the Institute, one of them showed marked deficiency in both selectivity and sensitivity. In other words, it was not worth the price asked for it. The other was found to meet every claim of the manufacturer, and so has received a certificate and seal of approval from the Institute — a guarantee to POPULAR SCIENCE MONTHLY readers that the receiving set will perform satisfactorily

A SENSIBLE person does not expect to get as much for five dollars as he can get for twenty-five. By the same token, the fact that the Institute may approve both a five-dollar article and one costing twenty-five dollars, does not mean that one article is as good as the other. Neither, for that matter, does it mean that one is any worse than the other. It does mean, however, that each article is worth the price asked, and will do satisfactorily the work it is designed to do.

No service and guarantee of radio apparatus and tools on the comprehensive basis on which THE POPULAR SCIENCE INSTITUTE OF STANDARDS is conducted ever before has been offered to the readers of a magazine.

Radio sets, tools, and other mechanical appliances differ so widely that very different tests are required to demonstrate the value in each case; but in one respect all tests conducted by the Institute of Standards are similar—every article is given both a laboratory test and a practical test of actual use.

In many cases, also, inspection of manufacturing methods at the factory where a tool, for example, is made is helpful in determining quality, and such inspections are made by the directors of the Institute. Every possible effort is made to determine absolutely that products offered to readers of POPULAR SCIENCE MONTHLY are of good quality.

THE quality of a tool, of course, depends largely on the quality of steel from which it is made. Hence, one of the first necessities in establishing its grade is to determine the physical properties of the materials used in its manufacture. Then, in making certain tools, it is necessary that the steel receive the proper heat treatment; also that it should have a certain hardness and temper. All these factors must be investigated and tested. Subsequently, a special test relating to the particular tool under investigation must be devised and applied. While many of the existing types of testing machines are available for this purpose, it is necessary in many cases to perfect special machines that can be applied to the particular tool under test.

The complete plan of tests worked out by the Director of the Institute involves not only the use of well equipped laboratories and machine shops, but also the checking of all tests made by manufacturers where these are of value in determining the merit of any product.

AFTER the technical tests and investigations are concluded, the tool is put to practical use to determine what difficulties, if any, the average users may experience with it.

Since the prime purpose of the Institute is practical—to determine for the readers of POPULAR SCIENCE MONTHLY whether tools and mechanical instruments will do the work they are supposed to do—the new apparatus being developed for laboratory tests likewise is practical. It is designed solely to inform the man who wants tools or mechanical instruments what tools and instruments will give him satisfaction.

For radio sets, the tests are designed to gage electrical efficiency, selectivity, sensitivity, and mechanical construction. Besides being tested by the reception of ordinary broadcasting, the sets also are tried out in conjunction with a miniature transmitting station erected in the laboratory, which permits the tester to vary the strength of the signals to be received.

Loudspeakers and headphones are tested for tonal quality and distortion, not only in actual use with a radio receiving set, but also by means of special sound-producing apparatus. Vacuum tubes, tuning units, and other radio parts are similarly tested in actual use in receiving broadcasting and by means of specially arranged laboratory tests.

UP TO the present time, only tools and radio instruments have been under test. The scope of the Institute's work, however, will be enlarged gradually to include the testing of automobile accessories, paints, paint brushes, electrical apparatus, and many other kinds of merchandise.

It should be understood that although the Institute of Standards is financed and maintained by POPULAR SCIENCE MONTHLY, it functions as a separate, independent organization. Its standards will be determined, its tests arranged and conducted, and its decisions made entirely by its directors and their laboratory staff. The Institute will approve or disapprove an article only on a basis of facts revealed by scientific and practical tests.

THE POPULAR SCIENCE INSTITUTE OF STANDARDS is first and last a service for the readers of POPULAR SCIENCE MONTHLY. Its aim is to safeguard them in their purchases of mechanical equipment, and in order that the Institute may function with greatest efficiency and widest usefulness, readers of this magazine, in making purchases, are urged to make full use of its service.

By looking for THE POPULAR SCIENCE INSTITUTE OF STANDARDS' insignia, indicating approval, you can protect yourselves with the Institute's guarantee. Advice will be given freely, and may be accepted with confidence.

The seal of approval of THE POPULAR SCIENCE INSTITUTE OF STANDARDS. A list of the radio and tool products that have received this seal will be sent to you by the Institute on request

POPULAR SCIENCE MONTHLY will be glad to furnish, upon request, a list of products tested and approved by THE POPULAR SCIENCE INSTITUTE OF STANDARDS.

Driving the Store to Your Door

Novel "Taxi Grocery" Combines Unusual Service with Economy

By Lynn B. Dudley

SELLING foodstuffs from door to door—carrying the store to the customer—is not a particularly new idea in itself. The wagon of the food peddler is a feature of life in the towns and cities of this country that antedates the memories of the oldest of us. But it has remained for a concern in Detroit, Mich., to make use of the idea on a really large and useful scale by equipping a big motor van as a store on wheels capable of supplying families within a radius of 35 or 40 blocks with a complete stock of groceries, breads and cakes, fruits, green and staple vegetables, meats and drug sundries.

This novel motorized store is said to combine the desirable features of the "cash and carry" chain stores and of the higher price stores that deliver goods on phone order, without possessing the disadvantages of either. Thus, while the low prices of the chain store prevail, the busy housewife is enabled to do her own marketing without loss of time and without the inconvenience of carrying heavy packages a distance of several blocks.

Interior view of the new Detroit "taxi grocery," looking toward the rear. The goods are handily arranged on both sides, so that customers can help themselves. An ingenious overhead carrier system supplies a basket to each customer. In the foreground is a combined refrigerator-counter

THE "taxi grocery" is able to maintain these low prices while giving extraordinary delivery service, for several reasons. First, its upkeep is negligible compared with the overhead cost of operating an ordinary store. It has only one clerk, who also is the driver and cashier. Rent, light, heat, window displays, and other expense items that add heavily to the cost of conducting the usual store, and which, of course, are borne by the customer, virtually are eliminated.

Then, instead of drawing an indifferent trade from a radius of from three to five blocks, the traveling store covers an area of several square miles, and supplies a correspondingly large list of customers regularly. The result is that, whereas the receipts of the average chain store are less than $500 a week, those of the motor store are reported to be averaging well over $1000. Further, the increased number of customers over those of the average store has resulted in a turnover of stock unheard of in the grocery or meat trade. The turnover of the usual chain store is 13 times a year. That of the store on wheels is 100 times.

The floor space in the motorized store is 22 feet by 7½ feet. Ingenious arrangement of the commodities on shelves and in bins, each marked with its own price tag, permits 10 or more persons to wait on themselves at once without crowding. A large basket conveyed by an overhead carrier is supplied to the customer when she enters. Into this she places the goods she desires to purchase as she makes the round of the store; then the goods are checked and wrapped by the driver as she departs.

Cold meats for immediate use are carried as ordinary stock, but orders are taken for all kinds of meat, and deliveries are made on the following day. The car has only one show window—in the rear. In this vegetables and fruits are displayed. Potatoes and similar bulk vegetables are sacked in varying quantities all ready for the customers.

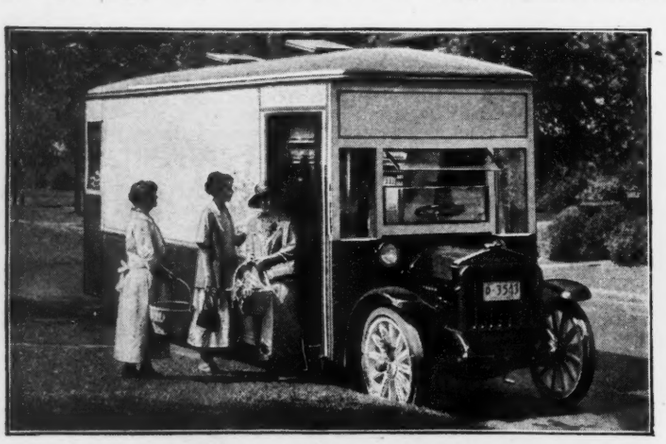
AN INGENIOUS system of hot-water heating from a central plant in the cooling system of the motor, keeps the traveling store warm during cold weather. Ventilators remove the odors of burning gasoline and oil.

The first taxi grocery was put in service by the Wright & Parker Co., of Detroit, as an experiment. The idea has proved so successful that a fleet of similar cars has been ordered, and a warehouse and garage are being built to develop the motorized grocery service on a large scale.

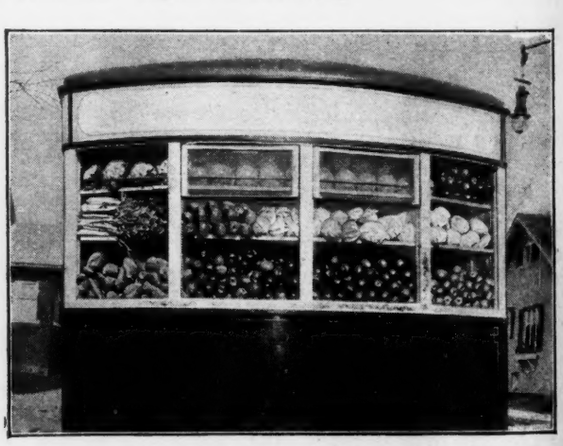
Improvements suggested by the trial of the first moving store will be incorporated in those that are to follow, and it is contemplated extending the range of service widely.

The plans include the addition of a laundry service and a banking system, as well as to take orders for coal and possibly other similar commodities for delivery on the following day.

Should these additional features prove successful, it is not impossible that this unique system of household service eventually may revolutionize the present-day system of distributing food and other household necessities, incidentally reducing the cost of living.



By bringing household necessities to your door, this novel "store on wheels" offers to the housewife the convenience of a delivery system plus the advantage of "cash and carry" prices. It serves a wide territory



The rear of the motorized store is almost entirely of plate glass, forming an attractive display window for fruits and vegetables. The goods are well displayed on three shelves

A Poor Man's $250,000 Gift to Science

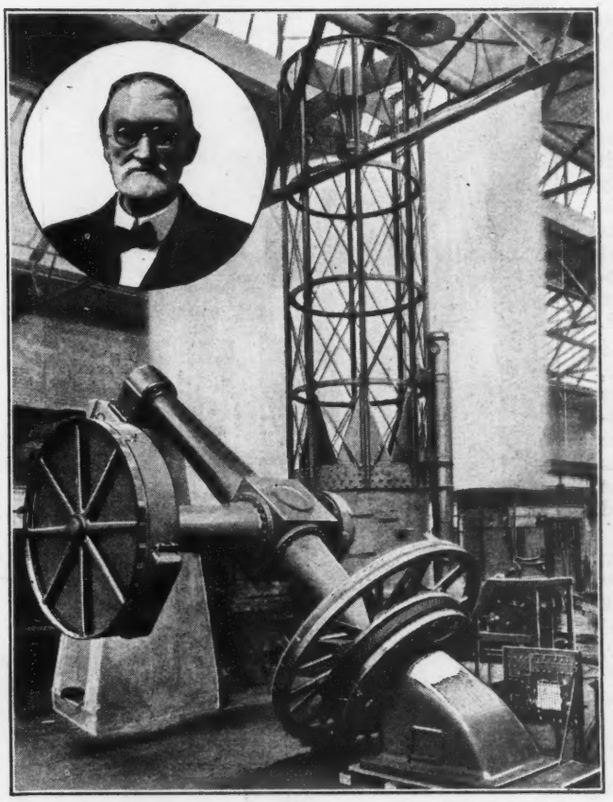
By W. D. Thomson

SOME time in the spring of 1925 there will be opened at Ohio Wesleyan University, Delaware, Ohio, an astronomical observatory that will house the third largest telescope in the world.

In itself that is a remarkable fact, for Ohio Wesleyan is a relatively small college, having less than 2000 students. Even more remarkable is the fact that the telescope, unlike other great astronomical instruments, is not to be used for research by learned scientists exclusively. On the contrary, its donor specified that it must serve, first the students of the university, then the general public, and research last of all.

But the most amazing feature of all is the circumstances under which the college comes into possession of its gift; for the telescope and observatory represent the achievement of one man's purpose, won at the cost of almost unbelievable self-sacrifice, perseverance, modesty, and steadfast devotion to the cause of science.

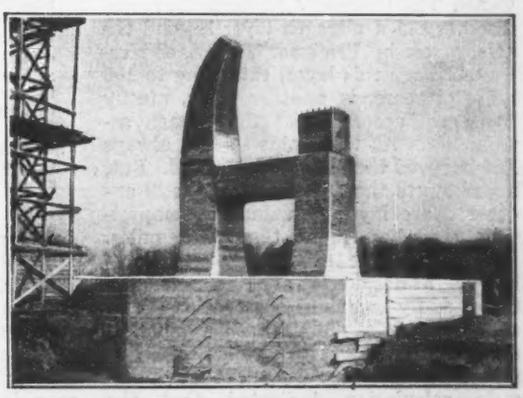
The telescope and observatory are the gift of the late Hiram Mills Perkins, for 50 years a member of the faculty of the university, who died a few months ago at the age of 90—a poor man.



The 60-inch reflecting telescope—third largest in the world—given to Ohio Wesleyan University by the late Prof. Hiram Mills Perkins (inset), who purchased it with the savings of a lifetime

He was poor from choice, because during his long life he had amassed a fortune of close to a quarter of a million dollars. Every cent that was his, though, went to purchase the telescope and observatory. To give Ohio Wesleyan modern astronomical instruments and to bring astronomy within reach of the masses were the objects to which he had dedicated his life. The cost of the gift—$250,000—was many times more than the total amount of money Professor Perkins received from the university during his half century of service. The highest salary he ever received was $1800 a year, and that for only a few years prior to his voluntary resignation as professor of mathematics and astronomy in 1907. The money for the observatory was derived from a series of investments extending through 50 years and carefully husbanded and reinvested with the sole purpose of buying the telescope.

Professor Perkins (center) turning the first earth for the new Ohio Wesleyan observatory. At his left is Dr. C. C. Crump, director of the Perkins observatory, and at his right, President John W. Hoffman of Ohio Wesleyan University, during the impressive ceremony



The 460-ton pier on which the great telescope will rest. The telescope itself will weigh 37 tons, but will be so delicately balanced that it can be operated by one man. Built in Cleveland, it is ready for installation in the observatory, which will be completed for use next spring

And when the time arrived that Professor Perkins was able to turn over to the university an amount sufficient to serve as the nucleus of a building fund, he tried to keep secret the fact that the money came from him, compelling B. E. Cartmell, treasurer of the university, to carry the account on his books as a donation from "Mr. X."

All the while that his small fortune was growing, he and his wife, with whom he had shared his secret ambition, did not change their modest scale of living. Professor Perkins never cashed the dividend checks from the enterprises in which he invested his money, but reinvested the return in securities; for each new opportunity of earning brought him closer to the achievement of his ambition. His sister and his brother - in - law contributed $75,000 to the telescope fund; otherwise the money came entirely from him. Only once did he and Mrs. Perkins relax from their rigid economy. That was when they took a trip around the world following the professor's retirement.

PROFESSOR PERKINS lived to fulfil his ideal, for it was he who broke ground for the observatory, while his wife, who died six months later, proudly watched the consummation of the purpose to which they had dedicated their lives.

Unusual mechanical features of the Perkins telescope will make it even more remarkable than the two instruments that surpass it in size—the 100-inch telescope at Mount Wilson, Calif., and the 72-inch telescope at Victoria, B. C. It has a 61-inch lens, and weighs 37 tons, but it is balanced so delicately that when moving with the earth's rotation to keep an observer's vision focused steadily on a star, it uses no more electric current than a household electric light.

Thirty motors are required to adjust the Victoria telescope. The Perkins instrument has but seven, and can be operated by one man. New safety appliances cause the instrument to stop moving instantly should the operator lose control of it.

New Discoveries in Science

The Top of the Air—Spring Fever—Radio—Automobiles—Health

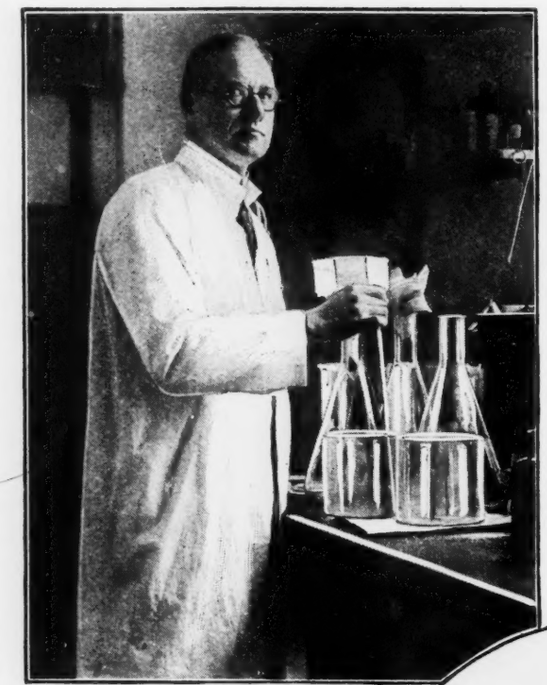
MAN devotes a lot of attention to the air these days. Now that radio concerts are drifting through the air for 24 hours a day and modern Magellans are using the air to circumnavigate the globe in flying machines, the air has achieved an importance never accorded to it in the days when it was employed almost exclusively for breathing purposes. And in view of the new fame it has achieved, it is a coincidence that science has discovered that apparently more air surrounds the earth than ever has been suspected.

A few weeks ago the Abbé Moreaux, noted French astronomer, announced that scientific tests seemed to indicate that the atmosphere extended about 540 miles beyond the earth's surface. This is more than five times as far as science previously had estimated the atmosphere's height.

Of course, the atmosphere in its upper regions scarcely resembles the air we breathe. Up to about 10 miles, according to the Abbé Moreaux, is found the air we know, composed mostly of oxygen, nitrogen, carbonic acid, and a few rare gases with the supply of oxygen diminishing, as aviators and mountain-climbers have taught us.

Beyond the 10-mile point, to a height of about 60 miles, nitrogen is the predominating constituent of the atmospheric envelope. This region has no storms nor winds. This statement supports the recent discovery of a nitrogen layer beyond the atmosphere by Professor Vegard, of Norway. Above this layer, extending to 100 miles or more, is another layer, mostly hydrogen, according to the French astronomer. At this point science always had believed the atmosphere ended. But, according to the Abbé Moreaux, still another dense layer of unknown composition stretches more than 400 miles.

The apparent existence of this unknown atmospheric stratum was determined by ingenious observation of the aurora borealis. Simultaneous exposure of more than 600 photographs from different points and subsequent trigonometric calculation indicated that the aurora extended its electrical manifestations 540 miles above the earth. It was assumed that these phenomena could not display themselves in empty space, and it was concluded in consequence that there must be some sort of atmosphere 540 miles or more away.



© Keystone

On the theory that fatigue is a bodily poison for which there should be a definite remedy, Dr. Fred B. Flinn, of the United States Public Health Service, is studying the effects of industrial labor on the human mechanism. He is shown above in his laboratory investigating the effect of sodium-dihydrogen phosphate in delaying fatigue. A German physiologist claims to have administered this salt to shock troops during the world war, with the result that they were less tired than usual at the end of a battle

Science and "Spring Fever"

THIS is the time of year when you should be able to do your best work. Strangely enough, though, this also is the time of the year when you are most likely to have a mental breakdown.

These paradoxical statements were made to the American Meteorological Society recently by Dr. Frank P. Norbury, reporting the results of an investigation into the relation between climate and physical efficiency. In the late spring and early summer, Doctor Norbury asserts, man is stimulated into activity, and consequently works best. Under the prodding of his new-found energy, he is likely to work so hard, though, that he'll become exhausted. Then, if he has a natural tendency to mental disorders, collapse will come. Man is more closely dependent on nature, and particularly on the weather than he ever has realized, declares Doctor Norbury.

New Gasoline Substitutes

IT WILL be a long time, American automotive engineers assert, before automobiles in the United States will employ generally any fuel besides gasoline. This is because gasoline is so plentiful here and because the gas-driven engine has been developed to such efficiency. In other countries, though, gasoline is obtained neither so cheaply nor so conveniently, and this explains the activity of foreign engineers in experimenting with other motor-car fuels.

In Sweden, for example, a native-built car run by alcohol is said to have given remarkable performances. The gasoline used in Sweden comes from America, and is expensive. In addition, virtually all cars there are imported. Therefore the alcohol-propelled vehicle naturally aroused much interest among those who before had been unable to afford a car.

Government restrictions probably will impede for a time the growth of the motor industry in Sweden, for prohibition there has placed the manufacture and distribution of potable alcohol under strict control. However, one solution of the problem is offered through the development by German chemists of a method of producing wood alcohol by the chemical combination of carbon monoxid and hydrogen. This revolutionary process is said to be capable of providing wood alcohol in quantities for little cost.

Meanwhile French automobile industries, through the use of gas generators, generally are replacing gasoline as a source of power in agricultural motors, such as tractors and plows. These generators, which burn coal, coke, or charcoal with equal success, also have been used on automobiles. It is entirely possible that as a result of these experiments there may be developed a new type of auto.

By means of an instrument known as a millivolt meter, shown above, Dr. I. F. Hand of the U. S. Bureau of Agriculture, has succeeded in recording and measuring the heat radiated by the sun. Doctor Hand estimates the amount of heat from the sun in midsummer to be about one horsepower a square meter

Nitrogen Tube for Radio

WHILE experimenting with a two-element nitrogen-filled tube in the physics laboratory of the University of Pennsylvania recently, in an endeavor to determine the number of electrons in an atom of nitrogen, it occurred to Dr. E. E. Witmer and Professor Charles B. Bazzoni that the tube might be employed to pick up radio signals. The addition of a transformer and a headphone brought in perfectly the programs broadcast from a local station.

No ground connection, aerial or tuning apparatus was used. This experiment was undertaken without the idea of contributing any new principle to radio reception, yet it offers decidedly interesting possibilities.

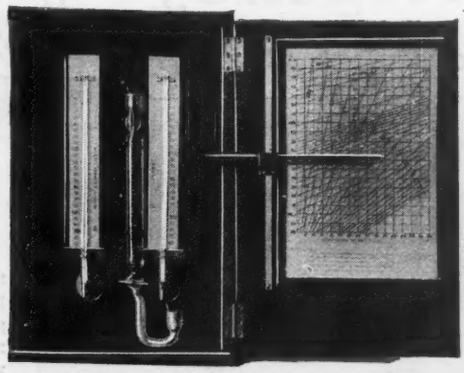
A Cure for Pyorrhea

FROM the University of Toronto, which gave the remarkable serum insulin to the world a year or so ago, came an announcement recently of another amazing discovery in medical science—a cure for pyorrhea, the supposedly incurable disease of the teeth and gums from which, physicians tell us, half the people in the world suffer.

Like Doctor Banting, discoverer of insulin, Dr. Harold Box, who is responsible for this new gift to science, is a young and hitherto obscure research worker.

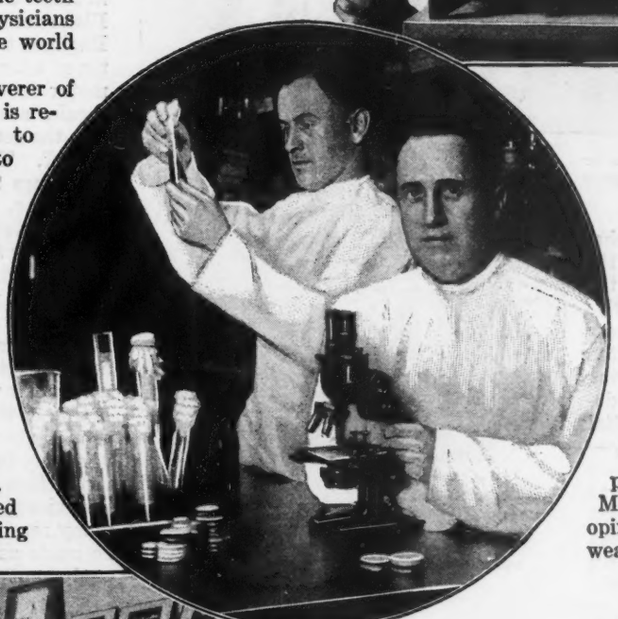
According to the announcement made by the university, Doctor Box has discovered that pyorrhea is not caused by infection, but by degeneration of tissues, and after five years' work, has found a means of arresting this action. Pyorrhea causes the gums to become painfully inflamed and to recede from the teeth, which eventually become loose. Hitherto, dentists believed there was no way of coping with the disease except by extracting the teeth.

Like insulin, Doctor Box's method of treatment has been turned over to the Government without restrictions, to be made available to the public.

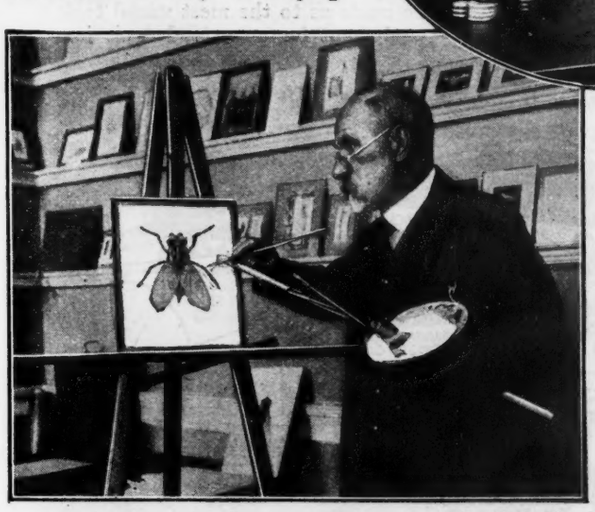


A view of part of the apparatus used by Professor McAdie in weighing human breath. The weight is recorded in kilograms to the cubic meter of space on the chart shown at the right

Prof. Alexander George McAdie of Harvard University is pictured above breathing into a delicate apparatus with which he has succeeded in measuring the weight of human breath. This instrument, known as the psychrometer, or chill measurer, somewhat resembles a thermometer, barometer, and scale. It weighs the vapor exhaled in breathing. In recent tests the breath of 200 students was found to weigh 360 pounds



The dangerous task of finding a serum to combat the dreaded Rocky Mountain spotted fever, carried by the little wood tick found on animals of the Montana mountains, has been undertaken by Dr. R. R. Spencer of the Hygienic Laboratories, Washington, D. C. Doctor Spencer is shown above seated at his microscope, while his assistant, L. H. King, is seen examining the blood of a guinea pig inoculated with the fever germ. Several experimenters already have given their lives in the fight against this contagious fever, which is accompanied by eruptions of small red spots, usually abundant over the trunk and limbs



One of the world's most extraordinary artists is Prof. L. H. Wilder of the United States Public Health Service. He is a painter of insects, bacteria, parasites, and countless living organisms so small as to be invisible to the unaided eye. The purpose of his work, accomplished with the aid of powerful microscopes, is to aid science in man's fight against carriers of disease. Professor Wilder is shown above completing, in true color, a painting of the common stable fly, which is said to be a carrier of infantile paralysis and other dangerous diseases

Paint as a Disinfectant

PAINT now is being hailed as an effective germicide and disinfectant.

The Institute of Industrial Research in Washington, D. C., demonstrated by actual test recently that germs cannot find lodgment on a freshly painted wall, since the paint closes up the pores of the material and prevents it from absorbing the moisture necessary to germ growth.

The New York City Health Department has begun the practice of painting, rather than fumigating, the rooms occupied by sufferers from contagious diseases. From a maternity hospital in Chicago has come an even more surprising story of the value of paint in combatting disease. A short time ago this institution harbored more than a hundred cases of puerperal fever. Then the hospital was painted, inside and out, and the puerperal fever virtually disappeared. More and more modern science is of the opinion that the most efficient health weapons are commonsense and cleanliness.

10,570 Miles by Radio

HERE'S a new DX record in radio: The British steamer *Port Kemble* reported to the United States Hydrographic Office recently that her radio equipment picked up the Washington, D. C., time signals while she was between Cape Town and Australia in approximately 46° south latitude and 95 degrees east longitude. That made her 10,570 miles away from the source of the signals. That's just about as far away as one object on the earth can get from another.

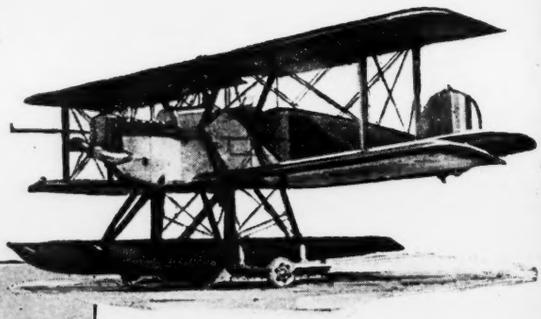
A Car that Runs Sideways

A MOTOR-CAR that can go forward, backward, and sideways to the right or left with equal facility recently caused quite a sensation in London. This queer vehicle also can leap a ditch, climb the highest curbstone without jar, and turn completely around in twice its own length.

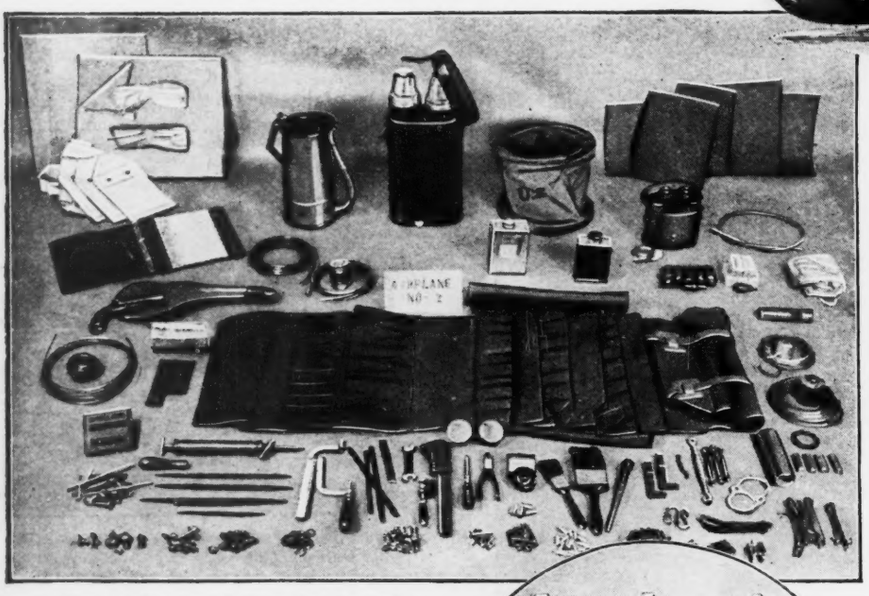
The car derives its unusual abilities from the fact that each wheel is independent of the other.

World Fliers Ready for Any Emergency

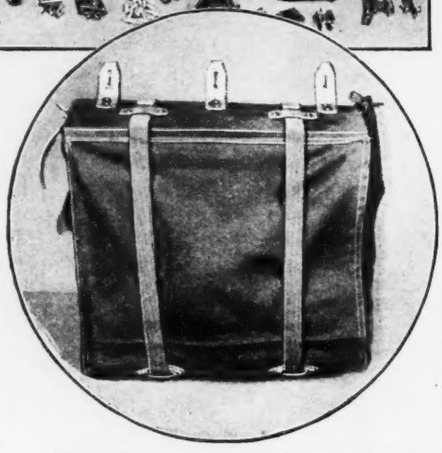
By Corley P. McDarment



One of the four Army world cruiser airplanes, showing pontoon equipment for emergency landings during sea flights



The contents of one of the airplane toolkits for the flight around the world, now in progress



The tools are carried in this compact bag, measuring only 17½ by 16 by six inches

SOARING out over the long stretches of the Pacific, skimming over the endless deserts of Persia, or the jungles of India, or coming down with motor trouble among the floes of summer ice off the coast of Greenland, the United States Army aviators who are flying around the world in four specially designed planes have at least one substantial source of comfort for any emergency—that is a fully equipped toolkit.

When the great world flight was planned, the matter of a proper toolkit was considered carefully, with the result that the kit carried by the modern Magellans is one of the most complete and compact ever assembled.

Packed in a cloth container measuring 17½ by 16 by six inches, are nearly all the necessities for repairing plane or motor. It is amazing how much can be placed in so little space. Besides wrenches, files, screwdrivers, safety wire, turnbuckles and extra spark plugs, are accessories like thermos bottles, collapsible water bucket, block and tackle, field glasses, paint brushes, hand ax, blowtorch, signal pistol, quart measure for oil, soldering iron, manifold connections, and copper tubing.

The crossing of the Atlantic and Pacific oceans presents the greatest difficulties of the flight. And the chance of forced repair work in midocean offers the most thrilling possibilities.

It will be remembered that Commander Towers of the United States Navy, during the transatlantic flight in 1919, was forced down near the Azores. After a remarkable repair job, he pulled into port on his own motor power, but "taxi-ing" on the water, since the waves prevented taking off again.

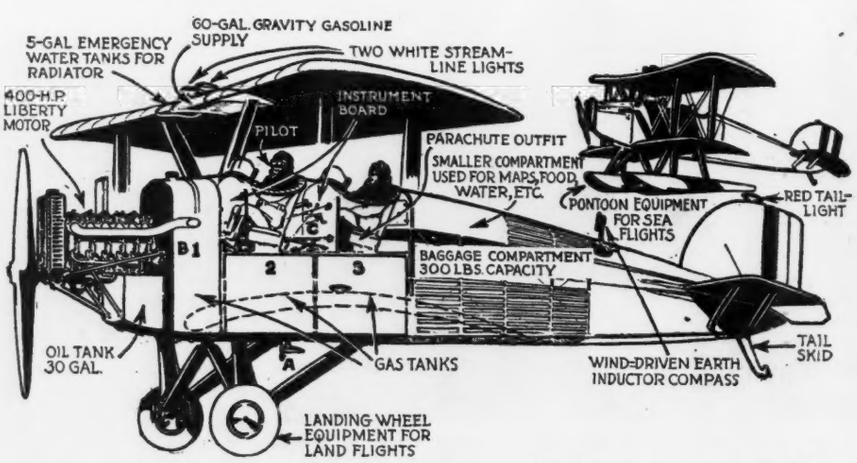
The four Army world cruiser airplanes are built high out of the water and the pontoons are tested to withstand ordinary gales and seas. A mechanic probably can make minor motor repairs on the ocean with the seas running.

THE most thrilling airplane wreck at sea, excepting the mishap of Hawker and Grieve, in their attempt to cross the Atlantic early in 1919, was the Macmillan and Malins disaster in the Bay of Bengal in August, 1922, during the famous Major Blake expedition which started from England to fly around the world. Three times when they were brought down by motor trouble, they were able to make repairs and to take off from the water. But the fourth time they were unable to get off. The rains began, water soaked the wings and fuselage, and the sea and wind rose.

The plane was overturned and sank slowly for four days, while the desperate airmen clung to the pontoons. Finally, they were picked up by a launch just in time to save their lives.

This was the first striking instance of an attempt by aviators to perform difficult repair work at sea.

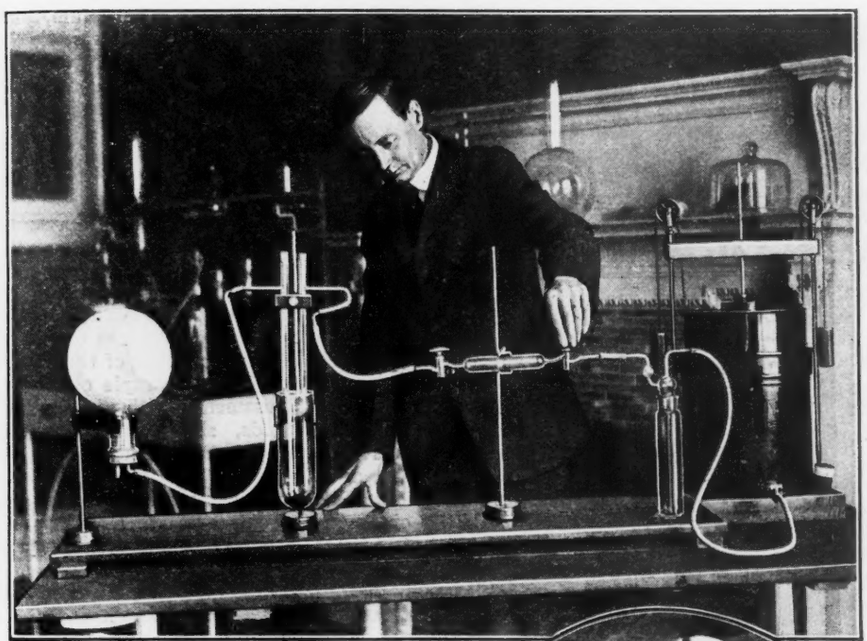
One of the objects of the present flight around the world is to study the problem of supply incident to long flights. In this connection the importance of the toolkit is obvious. When the flight is completed, many recommendations undoubtedly will be made as to the most useful tools and equipment for an extended air journey.



The special design and equipment of the United States Army world-cruising airplanes are shown above. One of the most remarkable of the safety provisions consists of three distinct gasoline systems. Gasoline from tank 1, 2, or 3 is pumped to the carburetors, either by a wind-driven pump (*A*), an engine-driven pump (*B*), or by a hand-operated pump (*C*), in the rear cockpit. In case all of these three systems should fail, there is a 60-gallon emergency gravity supply of gasoline in a tank located in the upper wing. The total gasoline capacity of the airplane is 450 gallons—enough for an 18-hour non-stop flight

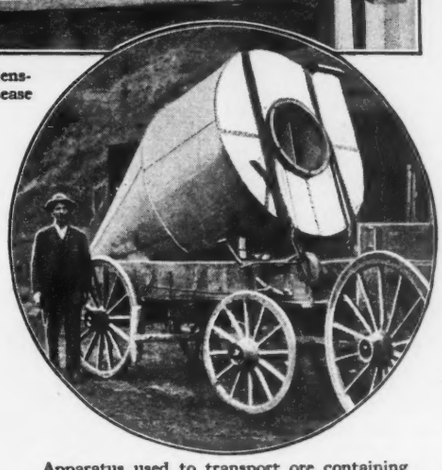
Nature's Magic in Radium

The Modern Philosopher's Stone and Its Wonder Secrets



Laboratory apparatus used in capturing and condensing radium emanations for the treatment of disease

In our April issue, Raymond J. Brown presented to POPULAR SCIENCE MONTHLY readers a delightfully graphic picture of the world of the infinitely small —the amazing world of atoms and electrons. In the same lucid, simple language he tells, this month, of the magic world of actuality—of Nature's wonder element, radium. Readers will watch with interest for a third article that Mr. Brown is preparing for the July issue, picturing the wonders of the heavens—the world of the infinitely large.



Apparatus used to transport ore containing uranium, from which radium is obtained

By Raymond J. Brown

THERE was a break in the radium market not long ago. The price suddenly plunged from $3,300,000 an ounce to $2,500,000, due to the discovery in Katanga in the Belgian Kongo of extraordinary deposits of a radium-bearing ore, from 25 to 30 times richer than the earth ever before yielded. Even more recently new fields of unusual promise came to light in some old copper mines in Czecho-Slovakia, a circumstance that may drive the market price down still further, though not to such an extent as 25 per cent.

These statements are likely to be misleading, for the standards and values by which we measure other things simply do not apply to radium, the wonder element. When you hear of the market price of radium being $2,500,000 an ounce, you immediately get the impression that if Henry Ford, say, desired to possess himself of a couple of pounds of radium, it would be necessary for him merely to put his checkbook in his pocket, fare forth to the radium marketplace, and carry the stuff back with him in a satchel.

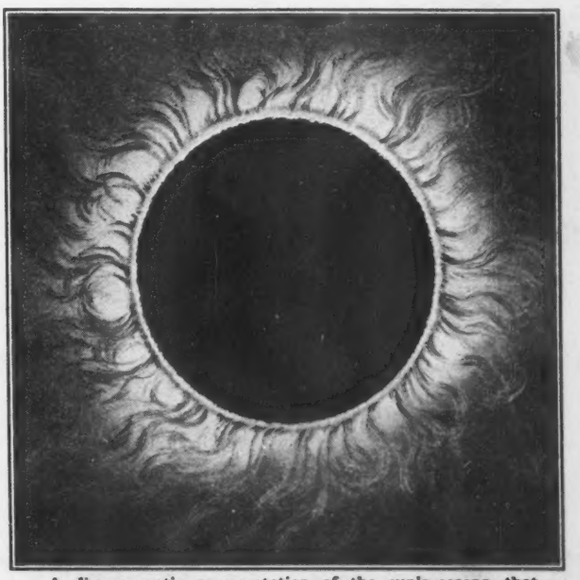
NOW, as a matter of fact, Mr. Ford couldn't buy a couple of pounds of radium. He couldn't do it if he had the Rockefeller and the Mellon fortunes and the output of the United States Mint to back his own resources. He couldn't do it for the simple reason that there aren't a couple of pounds of radium on earth. In the 26 years since radium was discovered, man has been able to store up less than a quarter of a pound of the precious stuff.

Those who have radium and need it — research scientists and physicians —would not part with their little stores at any price. Besides, radium is not sold by the ounce, any more than gold—which is more than 100,000 times less valuable—is sold by the ton. When radium does change ownership, it does so in fractions of a gram, and a gram is about one-thirtieth of an ounce. The largest consignment of radium ever moved consisted of only two grams, and that was not sold. It was merely lent to England by the government of Czecho-Slovakia for scientific research.

NOR is the discovery of a rich mine in the Belgian Kongo likely to make radium appreciably more plentiful. The ore taken from the new African mine contains merely from 25 to 30 times more of a *source* of radium than is found in the usual radium mine. Extracting the radium from this source is a lengthy, costly process. In fact, 500 tons of the first rock mined yields only a gram of radium in combination with barium and chlorin. And even this is accomplished only after the employment of 500 tons of chemicals, 1000 tons of coal, 10,000 tons of distilled water, and the labor of 150 men for a month! Moreover, extracting the pure radium requires five weeks' work by a corps of expert chemists, and four months more elapse before that single gram of radium is ready for use.

Think of it—six months' work to produce a bit of radium that would rattle around loose in the barrel of a fountain pen! One part by weight of radium extracted from 50,000,000 parts of ore after a half year of effort! A long, long time will pass before this new source of radium in the Kongo develops the half ounce necessary to bring the world's supply up to an even quarter pound!

Now, its rarity and value, though exceeding those of any other substance, are by no means the most amazing features



A diagrammatic representation of the sun's corona, that hurls tongues of fire thousands of miles into space, and that may spring from immense quantities of radium within

of radium. It is the one substance regarding which the most matter-of-fact scientist does not hesitate to utter superlatives, frame surprising theories, and permit his fancy to run free.

ASK the chemist about radium, and, after he had salved his scientific conscience by telling you it's a metallic element like iron, or copper, or zinc, and that it's one of the heaviest substances known (also true of lead), he'll probably go on and call it the supreme marvel of Nature's storehouse. He'll also tell you that it is the Philosopher's Stone, which the alchemists of old searched for as the agent that would effect the transmutation of the base metals into gold. And he will back up these surprising statements by scientific fact, as we shall see presently.

ASK the physician about radium, and he will tell you that it gives every indication of proving the most remarkable remedy ever given into the hands of science, and he will name the wide variety of uses to which medicine already has put it.

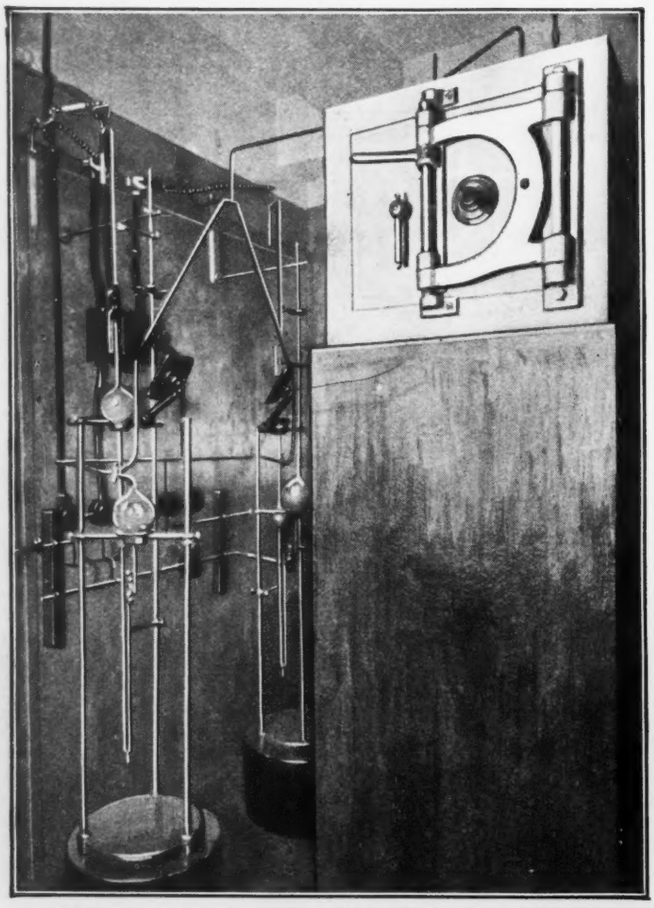
Ask the physicist, and he will call it the most marvelous tool ever placed in his laboratory. He will tell you how its strange properties enabled him to frame the amazing new theory of atomic structure that threatens to revolutionize all work in the natural sciences.

Ask the geologist, and he will tell you that radium offers a plausible, tenable explanation of volcanic action and the mysterious heat of the interior of the earth.

Ask the astronomer, and he will all but prove for you that radium is the source of the light and heat of the sun and stars, the secret of their seemingly eternal energy.

Ask the biologist, and he will go even further, asserting that radium may be the fountainhead from which sprang all life.

Ask the engineer, and he will tell you that, with sufficient radium at his command, he could develop power in unheard-of quantities and devise machines capable of performing work under which the mightiest machines of today would crumble!



Interior view of a lead vault in which the Radium Emanation Corporation of New York City stores radium for the manufacture of "radium seeds"—the tiny capillary tubes containing radium emanations that are supplied to physicians for the treatment of disease. Two grams of radium bromide is kept in a flask in the chrome nickel safe shown in the center. Within this safe are cooling coils to maintain constant temperatures, and the safe is lined with swansdown. Emanations from the flask pass through glass piping at the left to the exterior of the vault, pictured on the opposite page

Meanwhile industry utilizes its share of the pittance of available radium in the manufacture of the paints that illuminate watch hands, electric switches, compasses, and airplane instruments at night, and in making gems. Exposed for a short time to the action of radium, the colorless crystals of corundum (white sapphires) for example, turn permanently into blue sapphires—not imitations, but the actual stones themselves.

Now, what is the amazing property of radium that makes it so exceedingly useful?

The answer is—radio-activity.

Radio-activity means just what its name implies—activity in the form of rays. In a scientific sense, though, spontaneous action is meant.

The discovery of this phenomenon in 1895 by Henri Becquerel, famous French scientist, paved the way to the discovery of radium. Investigating phosphorescence, Becquerel noted that substances containing the element uranium affected a photographic plate in the dark, even when the plate was protected by black paper. And so 30 years ago the scientific world accepted as a new and startling fact the radio-activity of uranium, particularly as exemplified by its oxid—pitchblende, a pitchy, black mass found at Joachimsthal, between Bohemia and Saxony, and used for years in coloring glassware and porcelain.

SOME time later a young Polish woman studying chemistry in Paris became interested in this mysterious property of uranium. She obtained some pitchblende from the Joachimsthal deposits and began experimenting with it. She quickly came to the conclusion that the radio-active substance was not uranium, but some other constituent of the pitchblende. Reducing her sample of ore by washings, treatment with acids and similar methods, she noted that the radio-activity of the residue steadily increased.

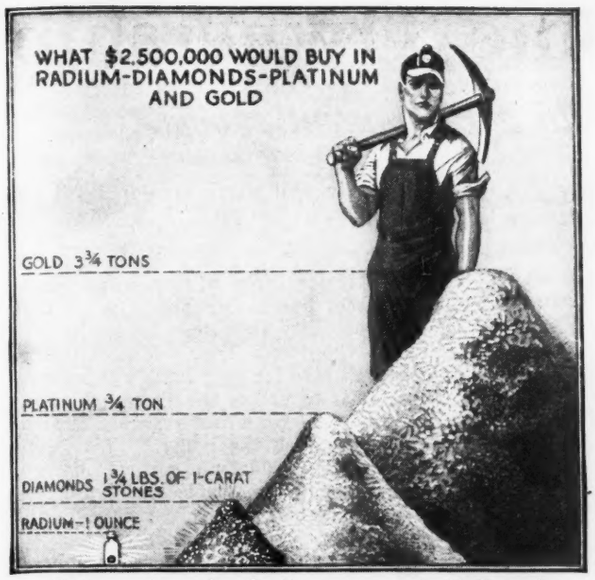
At last, from several tons of ore she obtained three ounces of a substance 60 times stronger than uranium by electroscopic test. This substance apparently had the properties of a chemical element, and the young experimenter announced her discovery, naming it polonium, in honor of her native land.

Steaming distilling vats in a radium refining plant at Pittsburgh, Pa. Ten thousand tons of distilled water are used in washing a single gram of radium from 500 tons of ore. In addition, 1000 tons of coal and 500 tons of various chemicals are required to obtain this one gram (about one-thirtieth of an ounce) of the wonder element

Further research, however, showed that the discovery of polonium was merely a step in the quest of the radio-active element, and after three years Madame Curie, for that was the name of the experimenter, announced that at last she had isolated the source of the radio-activity of pitchblende. Thus was the wonder element radium given to the world.

GRADUALLY science learned more about radium. Sir Ernest Rutherford in England discovered that its rays were of three kinds, and he used the first three letters of the Greek alphabet to distinguish them, calling them alpha, beta and gamma rays.

Alpha rays were found to be positive charges of electricity, moving at a rate of 20,000 miles a second, about 40,000 times faster than a cannon ball. These have small power of penetration and can


WHAT $2,500,000 WOULD BUY IN RADIUM-DIAMONDS-PLATINUM AND GOLD
GOLD 3¾ TONS
PLATINUM ¾ TON
DIAMONDS 1¾ LBS. OF 1-CARAT STONES
RADIUM-1 OUNCE

The tremendous value of radium as compared with diamonds, platinum, and gold. In the 26 years since radium was discovered, man has been able to store up less than a quarter of a pound of the wonder element. Owing to its extreme scarcity, it is more than 100,000 times as valuable as gold

be stopped by a paper-thin sheet of glass.

The beta rays were demonstrated to have a velocity ten times greater; virtually the same as that of light. These were found capable of penetrating the skin to a depth of half an inch and of passing through thin sheets of glass or aluminum, or a lead plate one-twelfth of an inch thick.

THE gamma rays were almost identical with X-rays, but of shorter wave length. These have the greatest penetrating power, finding their way through 10 inches of lead.

But an even more remarkable discovery was that the alpha rays, after their emanation, collected in some mysterious manner two negative charges of electricity, or electrons, and became atoms of helium! In other words, radium was steadily giving off another substance, as widely different from radium in chemical characteristics as any two substances could be!

And from this mysterious casting off of helium atoms by an element that contains no helium, science has arrived at some of its most startling conclusions. It has formed the theory, for example, that all matter in the universe is electricity. It has found a believable solution of one of the most profound mysteries of the universe—the source of the sun's light, heat, and energy.

Helium was discovered in the sun long before it was found on earth. The spectroscope demonstrates that there are huge quantities of helium in the sun's corona, the flaming halo that surrounds it and hurls its tongues of fire thousands of miles into space.

Does not the presence of helium in this fiery ring argue the presence of radium in huge quantities in the sun's interior? Further, is it unreasonable to suppose that *all* the light and heat of the sun spring from the terrific energy unleashed as countless tons of radium hurl into space their storm of radio-active beams?

A single gram of radium gives off enough heat to melt its own weight in ice in three-quarters of an hour. If the sun, which is 100 times larger than our globe, were composed in large part of radium, would not that explain its terrific heat?

Science knows that the sun's heat is not due to combustion. Radium, too, emits heat without rapid combustion. Also, the penetrating gamma rays of radium partake of the general nature of light waves. If billions of those rays were constantly shooting into space from the sun, might they not in the 93,000,000 miles they must travel to reach us, arrange themselves into the form of the light waves we know? This hypothesis supplies more than an opportunity for interesting speculation.

A similar process of reasoning supplies plausible explanation of the heat of the plastic materials that lie beneath the earth's thin crust, of volcanic action, boiling springs and geysers, and similar natural wonders regarding whose causes scientists long have wondered.

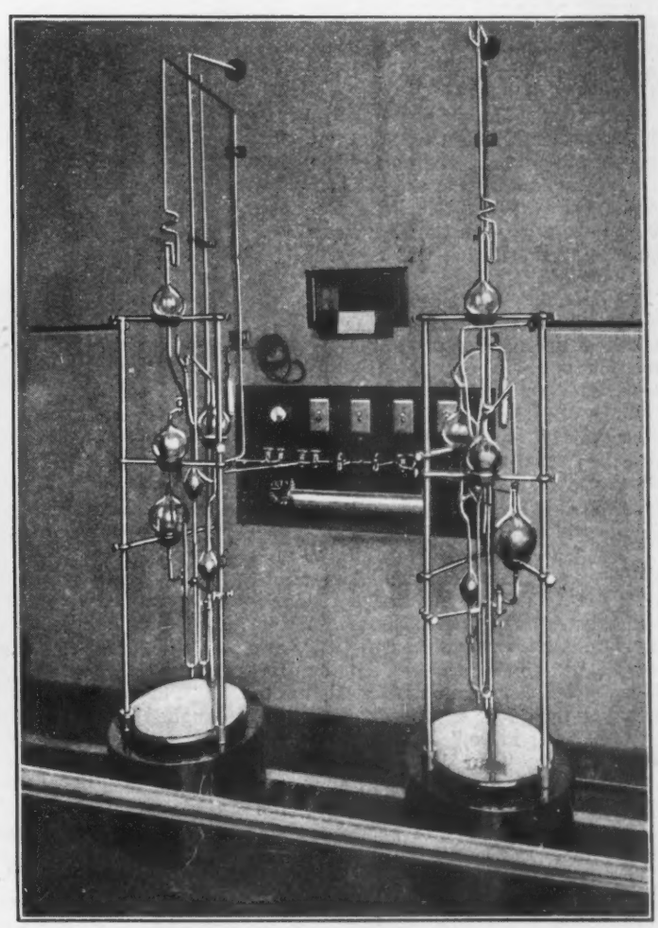
WHILE radium gives forth energy and generates heat without apparent loss of substance, it really is suffering a change. But the change is so slight as to be almost negligible. In the matter of heat, for instance, a gram of radium in a year gives off 1,160,000 calories—enough heat to boil 25 pounds of freezing cold water. In the process, though, the radium loses only 1/2500 of its weight.

In giving forth its rays, radium also alters its substance. From the rarest element known it transforms itself into a substance that long has served as a symbol of cheapness—lead. The transformation, though, requires 3460 years, so that radium hidden in the earth more than 1500 years before the Christian era has not yet become lead.

To the scientist, this is the most

(*Continued on page 129*)

Examining samples of radium-bearing ore in the laboratory of the United States Bureau of Mines at Denver, Colo.



Exterior of the lead vault for storing radium. The radium emanations piped from within continue to pass through piping that contains coils to remove water vapor and purify. At last the emanations reach a horizontal glass capillary tube, where it is collected. This tube is scarcely thicker than a hair. Every 24 hours or so, the tube is removed and divided into tiny sections, the ends of which are sealed. These are the "radium seeds," which are injected under the skin of patients in the treatment of cancer and other disease. A "seed" is worth about five dollars

Adventures in Home Ownership

Chapter III—We Plan to Build a Permanent Home

By Phil M. Riley
Noted American Authority on Architecture and Building

TIRED of paying apartment rent and determined to own a home of their own, Jim and Marion Hunter sought the advice of an old friend, an expert on home buying. The story of their search for a ready-built house, of how they found their hearts' desire, only to discover that the price was beyond their means, and how they finally decided to buy an inexpensive Dutch Colonial house to live in until Jim's expected increase in salary should materialize—all this was told in the two preceding chapters. Now read on:

IT HAD been a positive joy to look on as a neighbor and watch the happy life of Jim and Marion Hunter in their new home. To both of them and to their children, the move from a city apartment to their cozy suburban cottage among the trees had brought health and happiness such as they had not known before.

Although the modest home they had bought was not exactly what they wanted, it had answered its purpose admirably until such time as Jim's promised salary increase should materalize and they were able to build exactly the home they wanted.

Meanwhile Jim's firm and Jim himself, I knew, were making rapid progress, and so it was no surprise to me one Sunday morning, to hear Jim's voice on the telephone asking me to dine with them. I knew something interesting was afoot.

"WHAT'S the particular occasion?" I asked, following a ready acceptance prompted by recollections of Marion's wonderful home cooking.

"The occasion is to hold you to your word," he retorted. "You promised me some good advice whenever I might contemplate building a permanent home, and the time has come."

"Splendid!"

"Yes," said Jim with pride, "I'm a $7500-a-year man now, and can afford a $10,000 to $15,000 home. The Hunters are house-hunting again, but this time it's building lots and house plans, not completed houses, we're looking for. We've got a few plans here we'd like to have you look over with us."

"One thing more," Jim added, before hanging up. "Our little cottage here proved a good investment as you prophesied, and we've sold it at a profit of $1000, retaining right of occupancy for six months. In that time we ought to be able to build our own."

Two hours later found us seated about a cleared dinner-table, with a pile of building plans before us.

"These plans," Jim explained, "are all of houses specially designed for actual clients by an architect friend of mine. All of them have been built, though in other suburbs. I think you'll agree that each has individuality, and in this neighborhood any of them would be new."

"Any reduction for using them second-hand?" I asked.

"That's just the point," Jim went on. "We can have any one of them, if it suits us, without changes, for only a fraction of the usual three per cent of the cost of the house. If we should have the architect's supervision of the building, the cost would be the usual two per cent."

This, I thought, was the time for a word of good advice!

"But unless one understands building pretty well or has an exceptionally conscientious builder, the price of an architect's supervision is money well spent," I commented. "It places responsibility for good materials and workmanship on a competent, interested person."

Aided by the friendly advice of an expert, Jim and Marion study various architects' plans to decide on the home they are going to build for themselves

"Probably you're right," Jim agreed. "Anyway, it would mean only $200 on a $10,000 house."

"Where are you going to build?" I asked.

"That's one of the hardest problems," laughed Marion, as she spread out the first roll of plans. "But let's take that up as we consider the designs. We like our present location very much, and over on the next street there's a corner lot for sale on which we think this house would look well."

THE house in question was a simple, two-story, gable-roof structure with a porch and doorway with cheerful side-lights, somewhat Colonial in design, plenty of windows well spaced, a sun porch and attractive outside chimney at one end—a house with four attractive elevations that always would be in style and good taste.

"Surely well worth considering if the floor plan pleases you," I approved.

"YOU see," Jim explained, "the lot Marion spoke of slopes away from the street line rather abruptly, so that the rear party line is probably 10 feet below the street line. Many persons wouldn't care for such land, but see how easy it is to utilize the basement under the sun porch for a heated garage directly connected with the house. This would save about $1000 for a separate garage, while keeping the whole back yard free for a garden. It also gives a full-height cellar door, which is a comfort."

"And isn't that sun porch adjoining the living-room just a dear?" cried Marion.

"I certainly agree with you both," said I. "I notice, though, that there is no open piazza. To me, that means more than a sun porch. How about making the house more symmetrical by adding an open porch on the other end to balance the sun porch?"

"WE'D thought of that and wanted it," said Jim; "but the lot isn't big enough. It would add 10 or 12 feet to the present frontage of 47 feet, and the lot is only 75 feet wide. It would be crowding things."

"Of course you could have an open porch instead of the sun porch," I hazarded.

"But that would sacrifice one of the best rooms in the house," protested Marion.

"True," I had to admit. "Well, let's look at the floor plan."

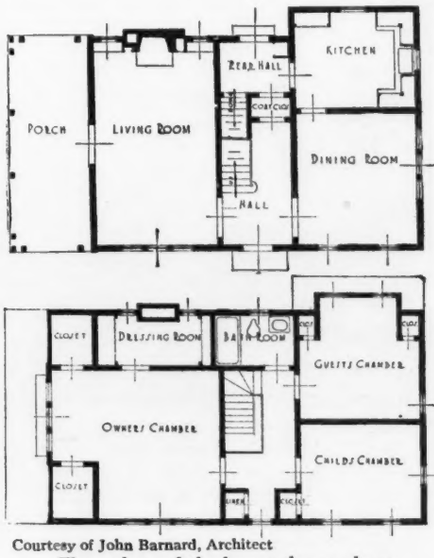
It proved to be not greatly unlike that of the house they were occupying, except for the wider central hall with winding stairway, and broad arches leading into the big living-room and dining-room on opposite sides. The living-room had windows front and back and glazed doors opening to the sun porch on each side of a

fireplace, which was situated midway of the length of the room.

A GOOD feature I noticed was a passage under the head of the stairway into the kitchen at the rear, a coat closet being located on one side of the passage and the cellar stairs on the other. The dining-room of ample size had the usual pantry between it and the kitchen, with provision for the refrigerator in the rear hall.

The upstairs floor plan called for four chambers of good size with ample closets, including one in the hall for linen. The bath was located at the rear of the hall above the kitchen; this for plumbing economy. At the front end of the hall a built-in table with drawers at each side provided a place at the window for the sewing machine, and, in effect, a sort of little sewing-room.

"That's something most architects leave out," said Marion, pointing to this interesting provision of the plan. "The home



Courtesy of John Barnard, Architect

Floor plans of the house shown above

really is more for the woman than the man, you know. She stays in it more, and these little things that make for her comfort are what makes a home homelike."

"Now the evidence is in, what's the verdict?" asked Jim.

"PRETTY favorable," I replied. "It's a home that you can build of brick, stucco, or wood, as you please."

"Here's a second one," said Jim, "that resembles the first in ground-floor plan, yet is entirely different in appearance. It is lower, almost a story-and-a-half cottage, yet has good second-floor rooms. It is a sort of modernized lean-to adaptation of the typical Cape Cod farmhouse, and has much of the feeling of those quaint old dwellings. This house would go well on that flat vacant lot across the street. It's hardly the thing for that sloping corner site so well suited to the first house."

"It surely is delightfully picturesque," said Marion. "But where is my sun porch? It always seems that to get one thing you want, you must give up something else that you value just as much."

"To get all the good features in one house would make some establishment of it," observed Jim sagely.

"The first-floor plan, you see," he went on, "has much the same central hall with the same winding stairway, but connects the front and rear halls through a coat closet, the cellar stairs descending from the rear hall. The dining-room is much the same, but the kitchen combines the

Courtesy of John Barnard, Architect

The house that Jim and Marion decided to build, making a few alterations in the plans to serve their needs. In design it is a modern adaptation of the Cape Cod farmhouse, and should cost about $12,000

pantry with it in one room, a common recent device, I'm told, to save both steps and work.

"AND notice the living-room. The fireplace here is at the back end, with built-in bookshelves on each side and doubled glazed doors at the middle of the long side wall opening on to the porch."

"What a cozy place that fireplace with the bookcases would be on a winter's night," said Marion.

"I'll say it would be!" Jim agreed. "That's just my idea of a real home picture."

"Again let's climb the stairs," urged Marion, spreading out the next sheet. "Here you see the bath is much the same; but I've lost my sewing-nook at the front end of the hall, the space being given over to closets. There are only three instead of four chambers, but the owner's chamber is a lovely big one, with two groups of three windows, two large storage closets under the long slope of the roof and a dressing-room with two wardrobe closets adjoining it at the back. How charming and comfortable it would be when rightly furnished!"

"Case number two closed," announced Jim. "What is the verdict, your honor?"

"Very favorable," I replied. "You have another design?"

"Yes, one, and to my way of thinking it's a pippin! You see; it's a scheme for a shingled two-story house after the Cape Cod manner. Its frontage is 75 feet, so it's really a country house. And therein lies a big objection," he added. "That frontage is too much for the average suburban lot. A 100-foot frontage at least is needed for such a house, and it really ought to be from 125 to 150 feet."

"Go half a mile or a mile farther out into any one of several good new developments I know of and you can buy half an acre of land at the price of 10,000 square feet here," I suggested. "Any of the houses you are considering, if built there, in five years will be worth 25 per cent more than it cost you because of the increased value of the land, which is more than can be said for property right here in this neighborhood. A home in a new development is a better moneymaker if you happen to want to sell it later."

"THAT sounds good to me, Marion," Jim exclaimed enthusiastically. "Suppose we look at some of this land?"

Marion agreed.

As Jim unrolled the plans of the third house I realized that perhaps it was the most interesting of the lot. By a simple, logical device a small house was made to seem much larger, while the structure had been given a picturesque individuality.

"Doesn't it look worth about $25,000?" Marion asked.

"Yes, that's the deceiving thing about it," said Jim; "for it can be built for about half that sum. What does most to create the impression of size is joining the garage with the house by means of a covered porch. This porch is a comfort in stormy weather."

"The same big living-room, you see," Marion explained, "except that much of the hall space is thrown into it to make it larger, the only separation being a heavy beam in the ceiling. Think how delightful this stairway would be winding around the fireplace!"

"Back of the hall and stairway," Jim put in, "is a service hall from which a coat closet, toilet and coalbin, or kitchen

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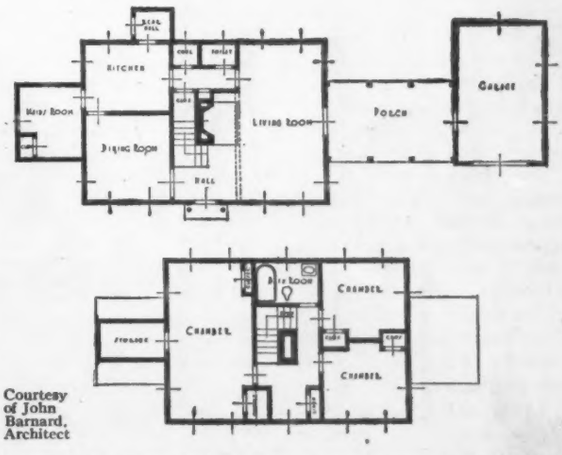
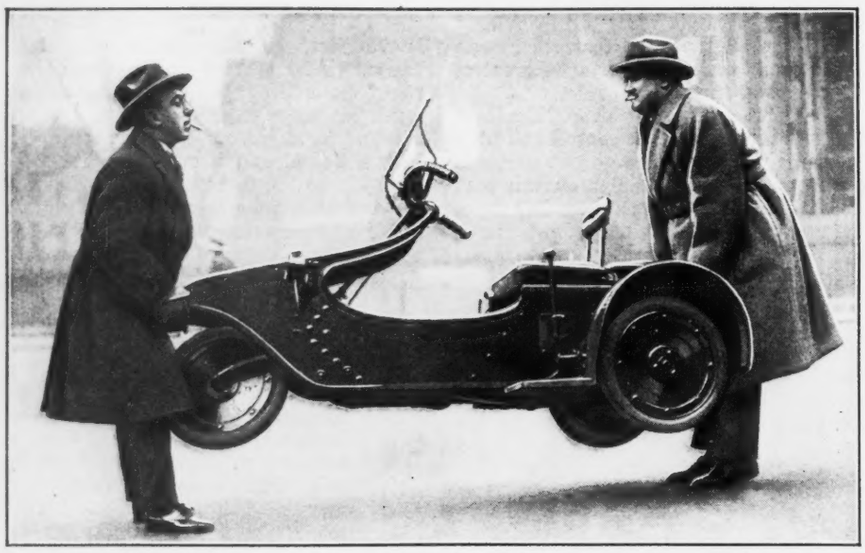


Courtesy of John Barnard, Architect

Unusually attractive floor plans of a two-story house of the Cape Cod farmhouse style. Note how the garage is connected with the living-room by a covered porch, in this manner making a comparatively small house seem much larger than it really is



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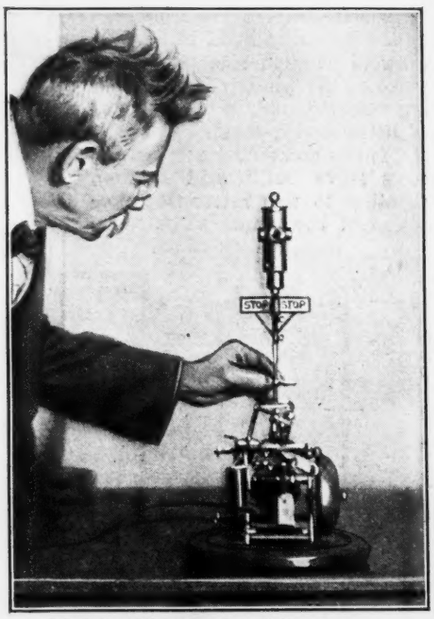

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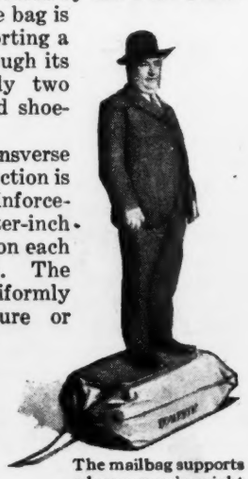

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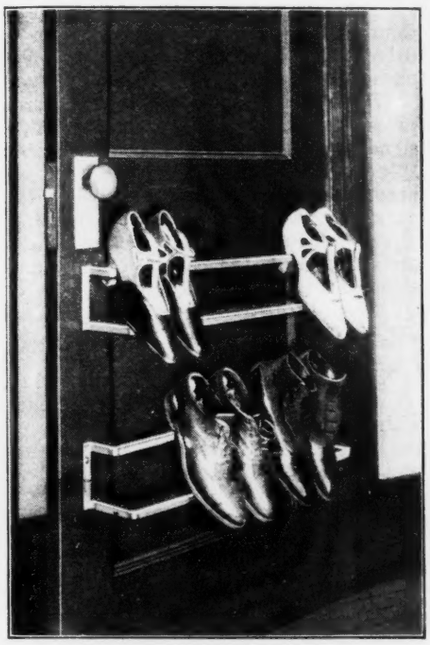

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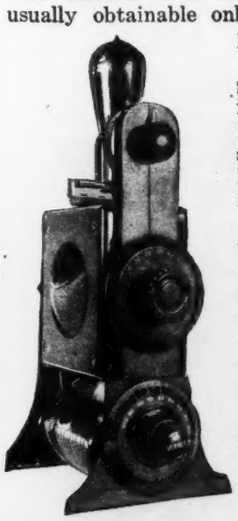
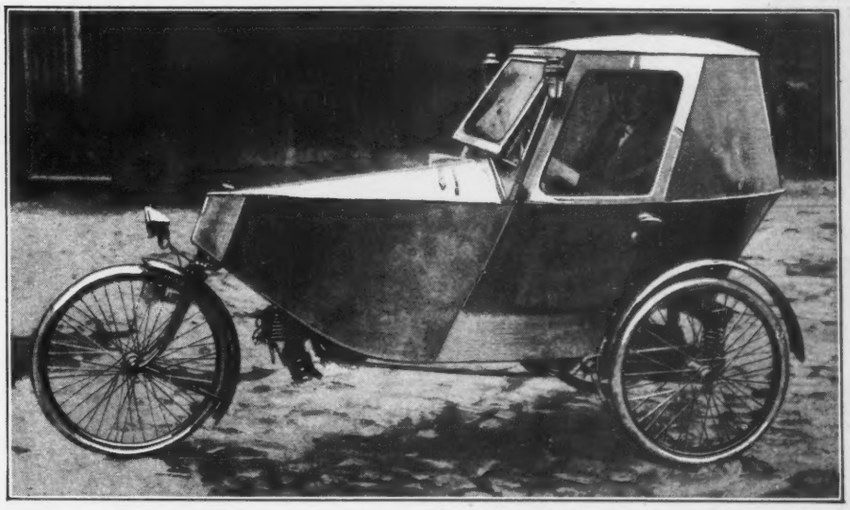


Midget vacuum tube set completely assembled



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The drawing together began at the bottom, men being stationed at various levels of the staging to tighten the bolts and so pull the irons together. The left portion of the chimney remained immovable throughout the work, so that when the work was finished the stack was vertical. The crack then was cemented, the bands being left on.

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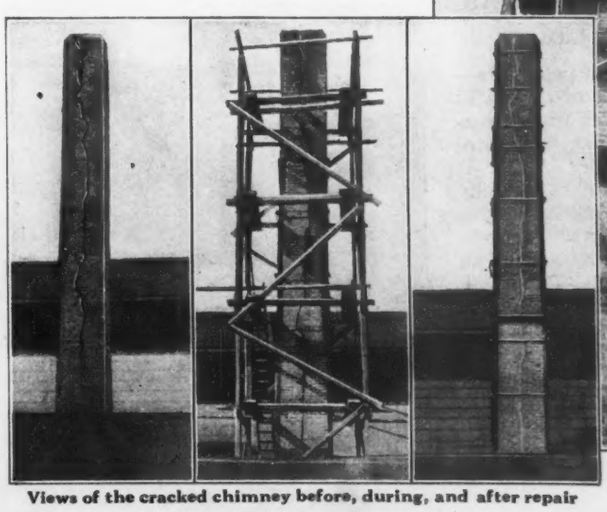

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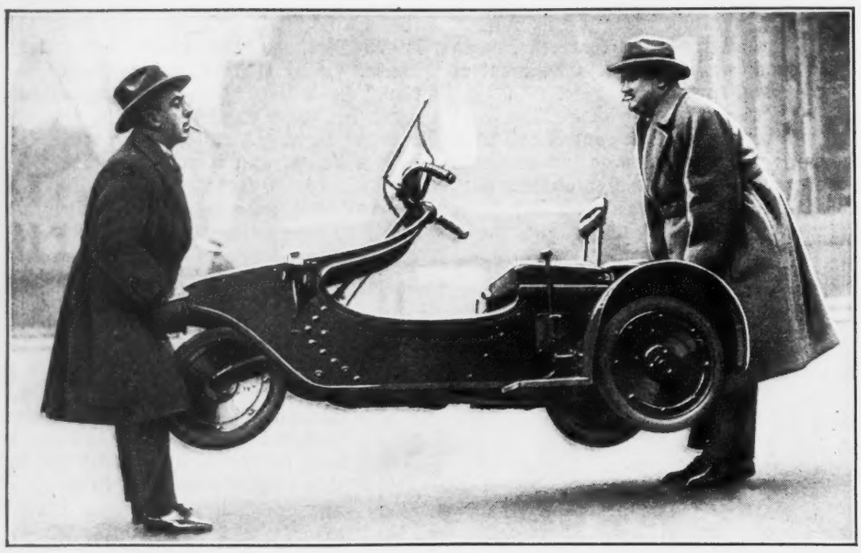

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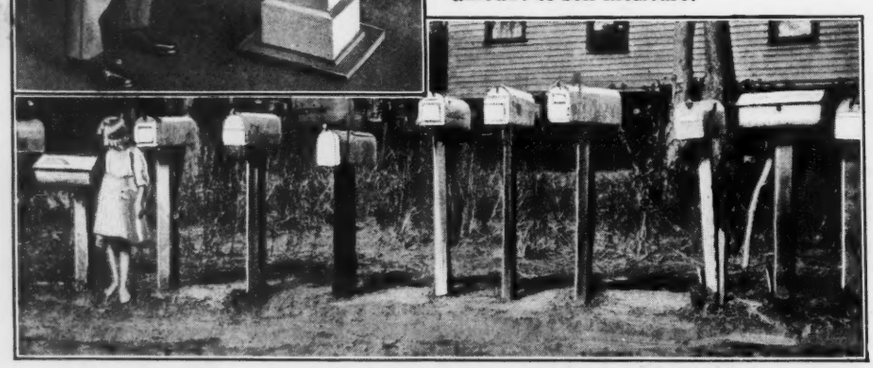

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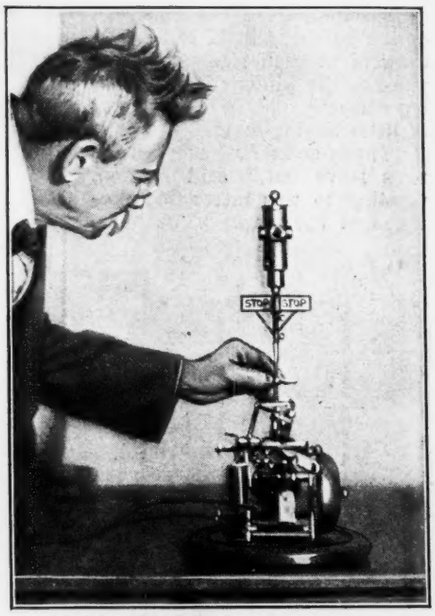

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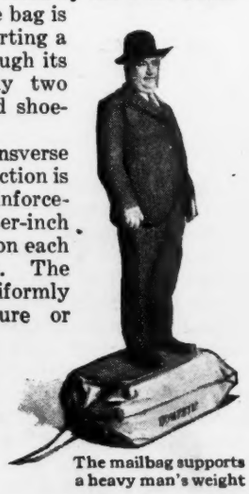

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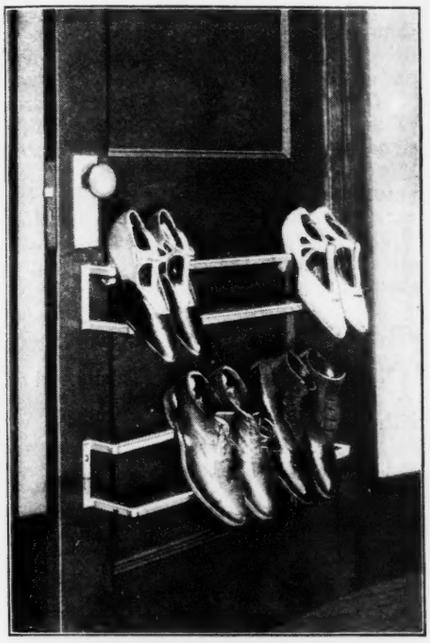

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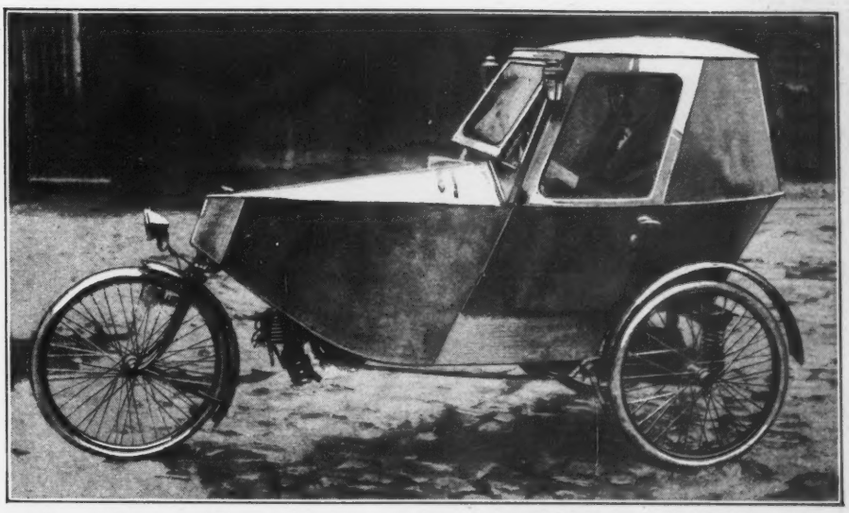

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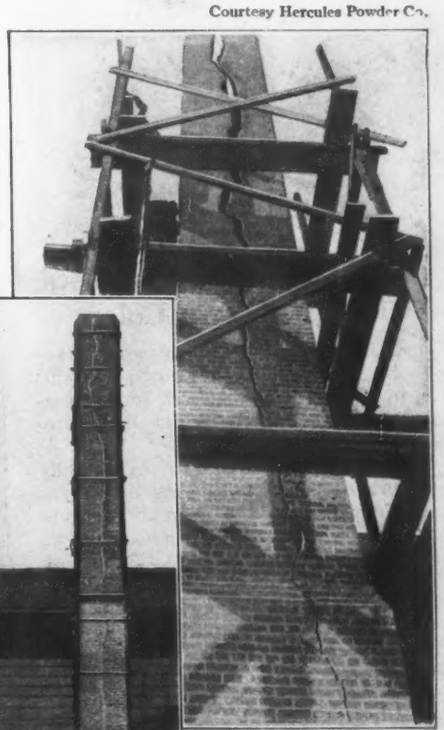

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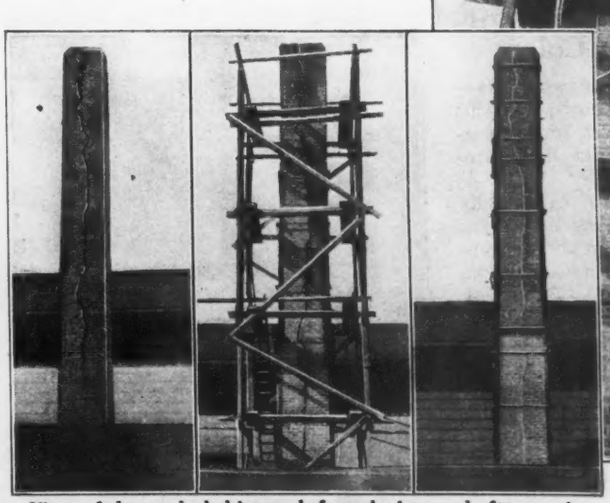

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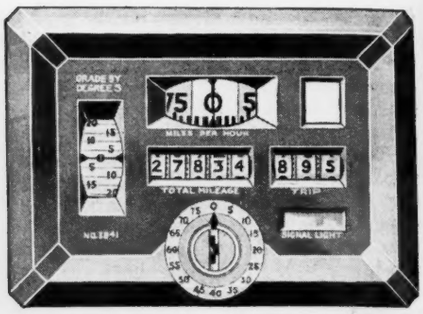
Metal Strip Alines Paper for the Typist

TO SAVE the typist time and annoyance, sheets of carbon are alined with sheets of paper by a simple metal strip attached to the typewriter frame just in front of the space bar. The strip is set at an angle to form a narrow trough into which the tops of the sheets are inserted. Jigging the sheets a little then alines them.

Indicator Stops Car when Speed Limit Is Passed



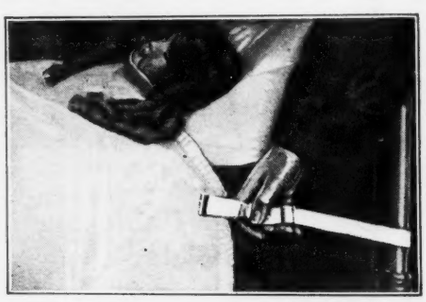
SETTING the bottom indicator on this new automobile speedometer at a certain number makes it impossible for a driver to go more than that many miles an hour.

When the car reaches a speed three miles less than that shown on the dial, a signal light flashes. When the indicated speed is exceeded, the ignition is cut off automatically, going on again when the car returns to the dial-indicated speed.

The instrument also indicates in degrees the grade the car is climbing and shows if rear light is burning.

Baby's Blankets Fastened

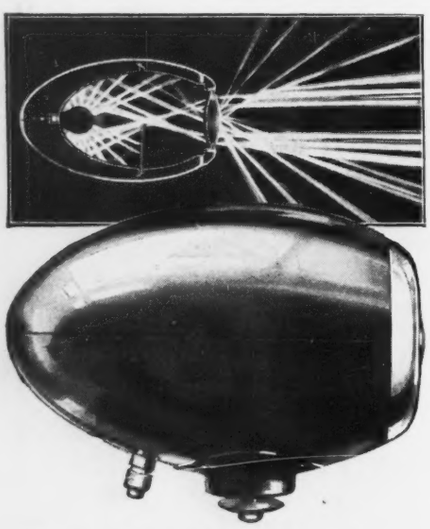
THE sleeping child is kept covered at night by this new blanket fastener with teeth that engage the upper edges of the covers. It is attached to the bedposts by an elastic band.



Water Gives Clue to Oil

AN ANALYSIS of the gases dissolved in underground water may give a clue whether the soil through which it has seeped contains oil. If it traverses sand containing oil or natural gas, it will dissolve a proportion of the hydrocarbons of which the oil or gas is composed.

When the water then is exposed to the air at the surface, the vapors will be driven off and their place taken by air. The vapors can then be analyzed. The United States Bureau of Mines has devised a portable apparatus that may be used for this purpose.



Powerful Headlight Casts Beams of Two Colors

A HEADLIGHT beam of two colors—intense white at the bottom and at the top a soft yellow filtered free of dazzling rays—is thrown by the new automobile lamp shown above.

Both the lights are said to be unusually brilliant because of the four-inch lens opening, made possible by an almost completely elliptical reflector, housed in an attractive egg-shaped casing.

Illumination of the road for a distance of 500 feet is possible, the inventor claims. Yet approaching motorists see only a strong but soft and harmless glow. The white portion is deformed by the lens to an inverted fanlike section.

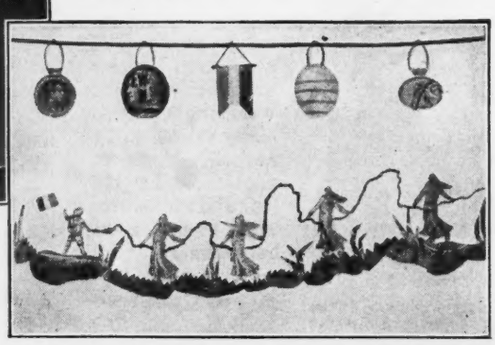
A novel focusing device makes it easy to adjust the position of the lamp filament.

Makes Odd Designs from Cancelled Stamps

CUTTING curious composite pictures and designs from canceled postage stamps of many nations is the unique hobby of George Gage, an artist of Brooklyn, New York.

He has found limitless the attractive and fantastic creations possible with a few stamps and a pair of scissors. The designs of the stamps, he says, have given him some of his best inspirations, although usually he adapts them to his conceptions. The many colors and varied, complicated designs of most stamps offer wide variety in arrangement and an interesting field for the hobby-lover.

George Gage, Brooklyn artist, is shown above cutting out cancelled stamps, which he uses in making unusual designs — his hobby. A number of his creations are shown in the illustration at the right

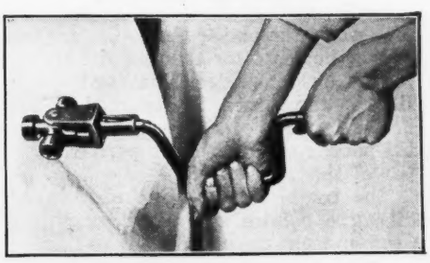


One Man Can Fell a Tree with This Dragsaw

CONVENIENTLY operated by one man, this dragsaw, which also can be used as a crosscut, makes tree-felling without a saw-mate far easier than heretofore. It is the invention of Frank Fox, Chesaw, Wash.

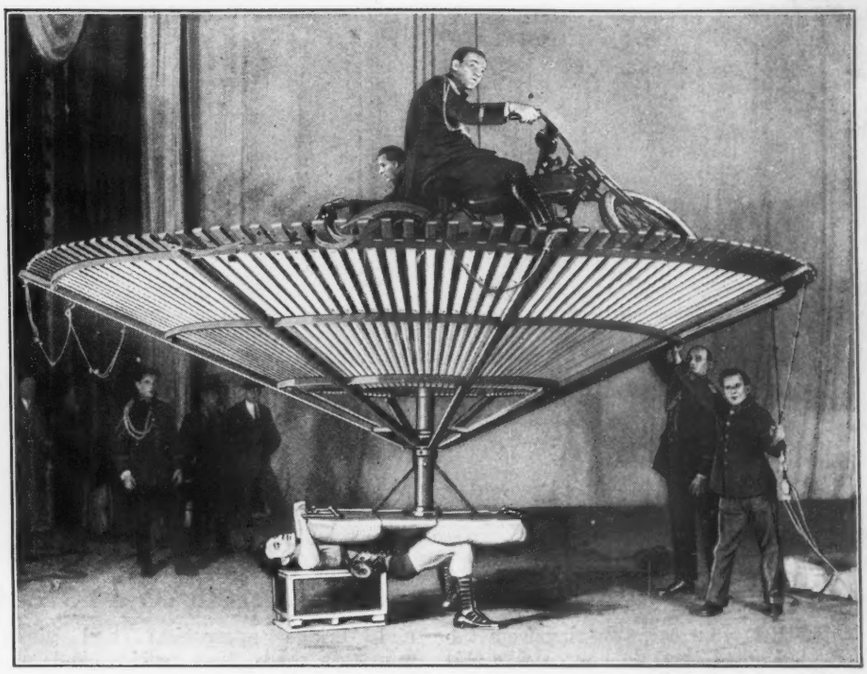
The free end of the saw is attached to a block, which slides on a thin plank. The plank is supported in a horizontal position by prongs that engage the tree, and by brace members supporting the end, as shown in the illustration.

A spring fastened to the end of the plank and also attached to the block tends to pull the saw away from the operator at the end of a cut. Where the saw cuts into the tree is a roller mounted on a spike or arm that is driven into the tree, preventing the saw from sagging.



A Four-Socket Wrench

ANY one of the four socket wrenches arranged in a turret head, as shown above, is made available instantly by a twist. The tool is designed for tire-rim work. The brace gives powerful leverage.



Supports a Motorcycle Race on His Chest

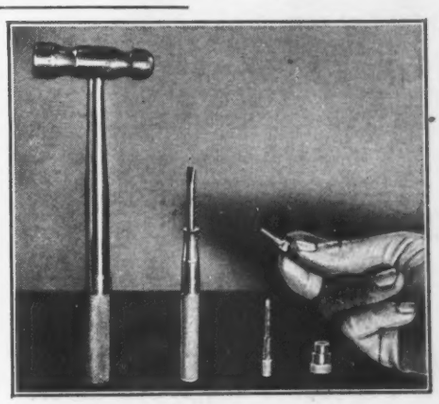
THE legendary feats of old-time strong men are made more plausible by this astonishing performance, verified by photography. Sigmund Breitbart, a Polish Samson, is shown supporting on his chest and knees a motorcycle track 30 feet in diameter, on which two motorcyclists are racing. The total weight supported by his powerful body is 3500 pounds—a ton and three-quarters.

Business Block Is Heated by Exhaust Steam

A WHOLE row of business buildings in Pittsfield, Mass., now is heated by the exhaust steam from a 750-kilowatt turbo-generator used by a local power company.

The steam is conducted to the generator through what is believed to be the longest high-pressure steam line in the world. It is 3600 feet long, carries the steam at a pressure of 195 pounds, and is built partly under and partly above the ground.

The pipe is eight inches in diameter and covered by three inches of insulation and a protective jacket of heavy duck. To waterproof the whole, a three-ply wrapping of roofing paper is used.



Three Screwdrivers and a Hammer in One Tool

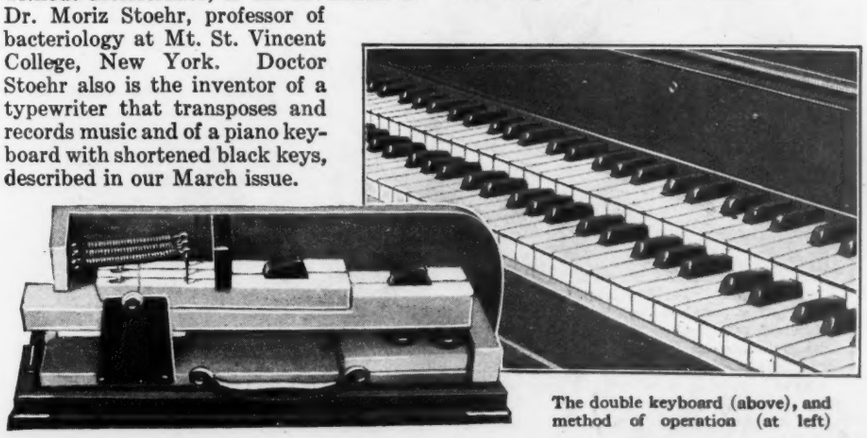
THREE screwdrivers in the handle of this machinist's hammer will serve for any size of screw ordinarily encountered, from the tiny ones used on portable typewriters to those in large strap hinges. A few twists of the handle fastens any one of them in the bit.

The hammer is 7½ inches long, and the drivers are 5½, 2½, and 1¼ inches long respectively.

Two Can Play Piano with Double Keyboard

A PIANO with two keyboards, similarly pitched, allowing two persons to play the instrument simultaneously, without interference, is the invention of Dr. Moriz Stoehr, professor of bacteriology at Mt. St. Vincent College, New York. Doctor Stoehr also is the inventor of a typewriter that transposes and records music and of a piano keyboard with shortened black keys, described in our March issue.

The double keyboard consists of two banks of keys shortened to fit in the space ordinarily occupied by one. Both keyboards operate the same hammers.



The double keyboard (above), and method of operation (at left)

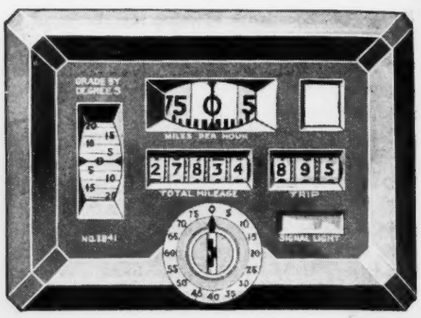
"Ivory" Grows on Trees

IN COLOMBIA, Peru, Ecuador, and Brazil, ivory grows on trees. Chessmen, ornaments, buttons, drawer-knobs, and other articles are made from this vegetable ivory which, when dried and cut, looks like the real ivory obtained from elephant tusks. It is gathered in the form of hard, white, fine-grained, oval nuts, about the size of a small potato, which drop from the wild tagua or ivory-nut palm.

Metal Strip Alines Paper for the Typist

TO SAVE the typist time and annoyance, sheets of carbon are alined with sheets of paper by a simple metal strip attached to the typewriter frame just in front of the space bar. The strip is set at an angle to form a narrow trough into which the tops of the sheets are inserted. Jigging the sheets a little then alines them.

Indicator Stops Car when Speed Limit Is Passed



SETTING the bottom indicator on this new automobile speedometer at a certain number makes it impossible for a driver to go more than that many miles an hour.

When the car reaches a speed three miles less than that shown on the dial, a signal light flashes. When the indicated speed is exceeded, the ignition is cut off automatically, going on again when the car returns to the dial-indicated speed.

The instrument also indicates in degrees the grade the car is climbing and shows if rear light is burning.

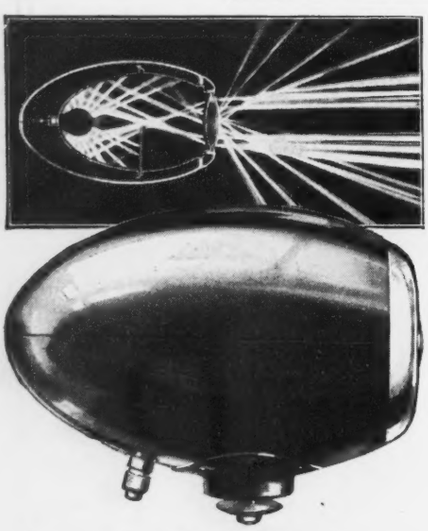
Baby's Blankets Fastened

THE sleeping child is kept covered at night by this new blanket fastener with teeth that engage the upper edges of the covers. It is attached to the bedposts by an elastic band.

Water Gives Clue to Oil

AN ANALYSIS of the gases dissolved in underground water may give a clue whether the soil through which it has seeped contains oil. If it traverses sand containing oil or natural gas, it will dissolve a proportion of the hydrocarbons of which the oil or gas is composed.

When the water then is exposed to the air at the surface, the vapors will be driven off and their place taken by air. The vapors can then be analyzed. The United States Bureau of Mines has devised a portable apparatus that may be used for this purpose.



Powerful Headlight Casts Beams of Two Colors

A HEADLIGHT beam of two colors—intense white at the bottom and at the top a soft yellow filtered free of dazzling rays—is thrown by the new automobile lamp shown above.

Both the lights are said to be unusually brilliant because of the four-inch lens opening, made possible by an almost completely elliptical reflector, housed in an attractive egg-shaped casing.

Illumination of the road for a distance of 500 feet is possible, the inventor claims. Yet approaching motorists see only a strong but soft and harmless glow. The white portion is deformed by the lens to an inverted fanlike section.

A novel focusing device makes it easy to adjust the position of the lamp filament.

Makes Odd Designs from Cancelled Stamps

CUTTING curious composite pictures and designs from canceled postage stamps of many nations is the unique hobby of George Gage, an artist of Brooklyn, New York.

He has found limitless the attractive and fantastic creations possible with a few stamps and a pair of scissors. The designs of the stamps, he says, have given him some of his best inspirations, although usually he adapts them to his conceptions. The many colors and varied, complicated designs of most stamps offer wide variety in arrangement and an interesting field for the hobby-lover.

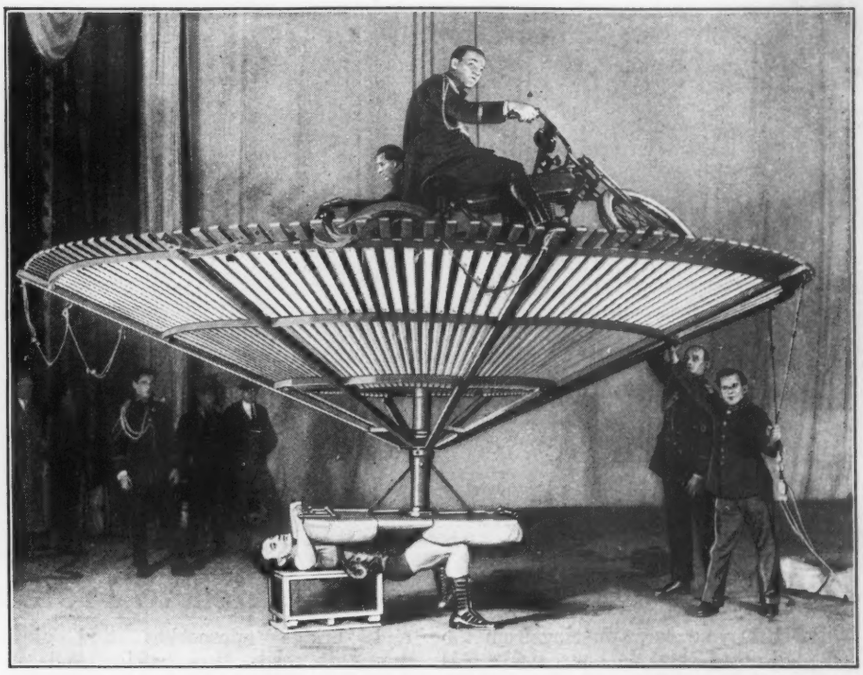
George Gage, Brooklyn artist, is shown above cutting out cancelled stamps, which he uses in making unusual designs — his hobby. A number of his creations are shown in the illustration at the right

One Man Can Fell a Tree with This Dragsaw

CONVENIENTLY operated by one man, this dragsaw, which also can be used as a crosscut, makes tree-felling without a saw-mate far easier than heretofore. It is the invention of Frank Fox, Chesaw, Wash.

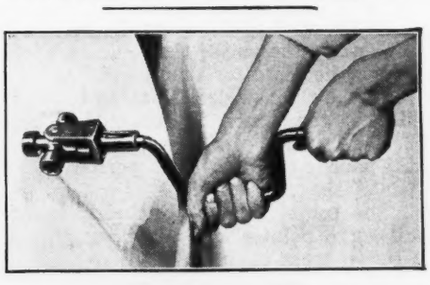
The free end of the saw is attached to a block, which slides on a thin plank. The plank is supported in a horizontal position by prongs that engage the tree, and by brace members supporting the end, as shown in the illustration.

A spring fastened to the end of the plank and also attached to the block tends to pull the saw away from the operator at the end of a cut. Where the saw cuts into the tree is a roller mounted on a spike or arm that is driven into the tree, preventing the saw from sagging.



Supports a Motorcycle Race on His Chest

THE legendary feats of old-time strong men are made more plausible by this astonishing performance, verified by photography. Sigmund Breitbart, a Polish Samson, is shown supporting on his chest and knees a motorcycle track 30 feet in diameter, on which two motorcyclists are racing. The total weight supported by his powerful body is 3500 pounds—a ton and three-quarters.



A Four-Socket Wrench

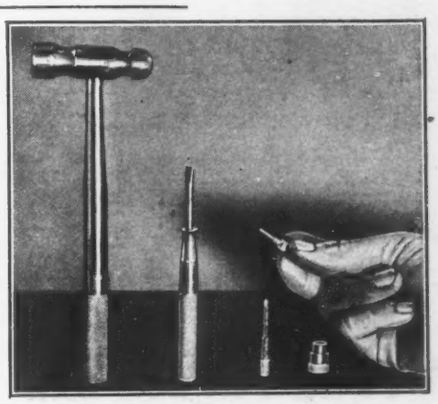
ANY one of the four socket wrenches arranged in a turret head, as shown above, is made available instantly by a twist. The tool is designed for tire-rim work. The brace gives powerful leverage.

Business Block Is Heated by Exhaust Steam

A WHOLE row of business buildings in Pittsfield, Mass., now is heated by the exhaust steam from a 750-kilowatt turbo-generator used by a local power company.

The steam is conducted to the generator through what is believed to be the longest high-pressure steam line in the world. It is 3600 feet long, carries the steam at a pressure of 195 pounds, and is built partly under and partly above the ground.

The pipe is eight inches in diameter and covered by three inches of insulation and a protective jacket of heavy duck. To waterproof the whole, a three-ply wrapping of roofing paper is used.



Three Screwdrivers and a Hammer in One Tool

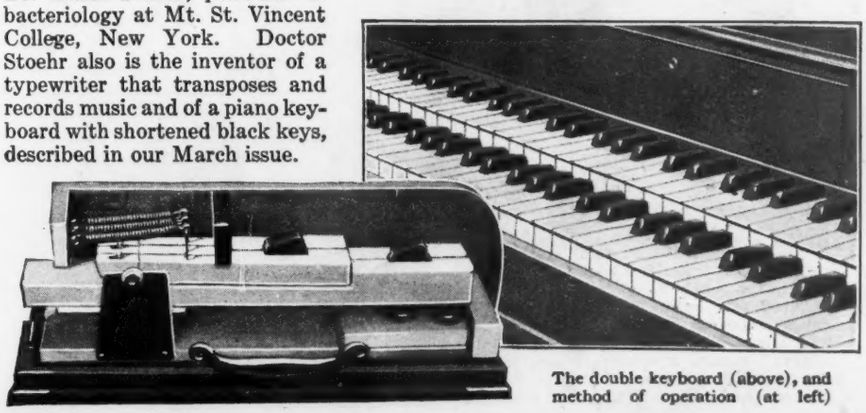
THREE screwdrivers in the handle of this machinist's hammer will serve for any size of screw ordinarily encountered, from the tiny ones used on portable typewriters to those in large strap hinges. A few twists of the handle fastens any one of them in the bit.

The hammer is 7½ inches long, and the drivers are 5½, 2½, and 1¼ inches long respectively.

Two Can Play Piano with Double Keyboard

A PIANO with two keyboards, similarly pitched, allowing two persons to play the instrument simultaneously, without interference, is the invention of Dr. Moriz Stoehr, professor of bacteriology at Mt. St. Vincent College, New York. Doctor Stoehr also is the inventor of a typewriter that transposes and records music and of a piano keyboard with shortened black keys, described in our March issue.

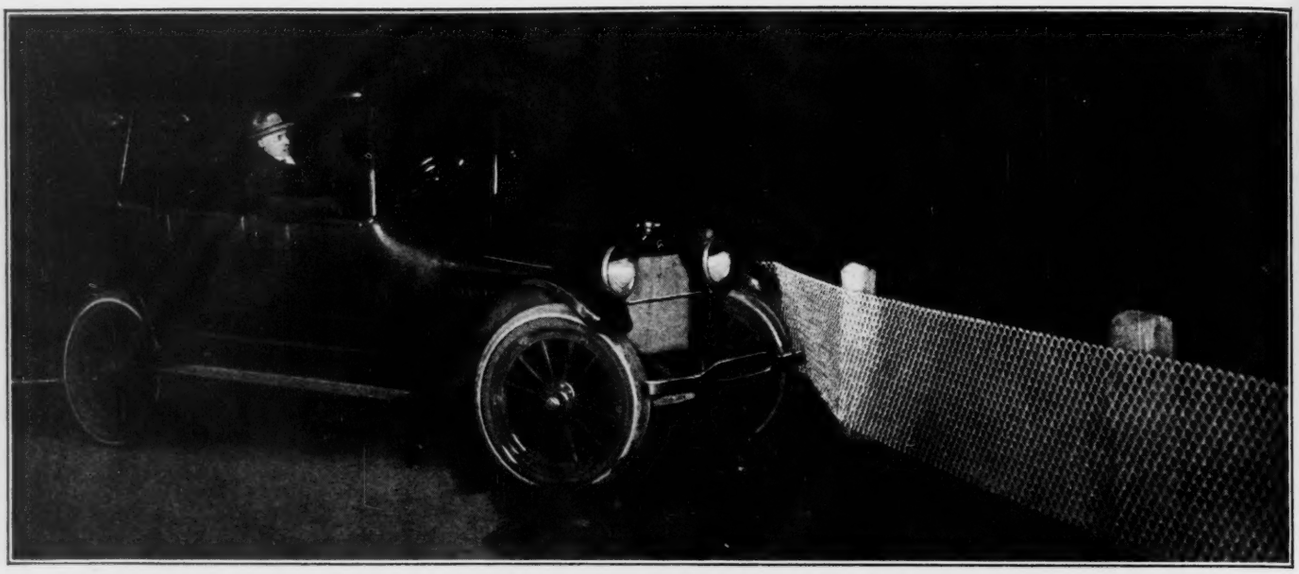
The double keyboard consists of two banks of keys shortened to fit in the space ordinarily occupied by one. Both keyboards operate the same hammers.



The double keyboard (above), and method of operation (at left)

"Ivory" Grows on Trees

IN COLOMBIA, Peru, Ecuador, and Brazil, ivory grows on trees. Chessmen, ornaments, buttons, drawer-knobs, and other articles are made from this vegetable ivory which, when dried and cut, looks like the real ivory obtained from elephant tusks. It is gathered in the form of hard, white, fine-grained, oval nuts, about the size of a small potato, which drop from the wild tagua or ivory-nut palm.



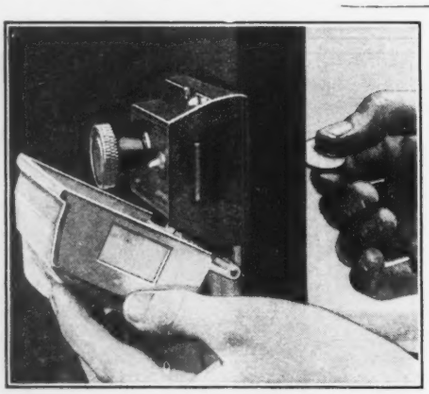
Elastic Roadside Fence Invented to Protect Cars from Disaster

SHOULD your car, swerving from the road at 45 miles an hour, strike this fence at the edge of an embankment, you would be halted unhurt, its inventors claim. The picture above shows the result of such an encounter in a test near Bridgeport, Conn.

Placed at dangerous turns, on bridges, and bridge approaches and along mountain roads, such fencing, it is asserted, would save scores of lives each year. Forty per cent of highway accidents are said to happen on such roads.

The fencing is of specially woven wire, rugged and elastic, elongating like a rubber band when struck. It stretches until the wires forming the meshes touch each other, so that it halts the car without sudden, destructive impact or injury to a car's occupants.

The recoil pushes the car back several feet if it is traveling moderately fast. At higher speeds, the fence conforms somewhat to the lines of the car.



Protector for Door Lock Keeps Burglars Out

SMASHING in the glass or wood panel of a door equipped with this new protected lock would not permit a burglar to unlock and open the door from within. Of course, he could go on and smash out a hole large enough to admit his body. But, besides the difficulty and time, the incidental noise would increase the danger of discovery and capture.

The metal protecting device covers the inside knob and catch of the lock, fastening over them automatically when the door is closed and releasing when the key is turned.

Melt Ice from Power Lines

A BALTIMORE power company has found a way to prevent sleet troubles along its lines. The company's operators keep close tab on the weather. When the ice begins to form, enough current is applied to the circuit to melt the sleet.

Success depends upon getting started before the sleet gains headway.

A Mechanical Memory for Card Players

WHOSE deal is it? The answer to this question often becomes a stumbling-block to an otherwise smoothly running card game. Few closely contested games progress far before there is a clash of opinion on this point or a frank confession of ignorance all around.

But now comes a newly invented scoring device equipped with a mechanical memory to relieve the situation.

It consists of a mechanism actuating a dial that points to each of the players in turn from right to left. This mechanism is actuated by pressure of the scoring pencil as it is thrust against the bottom of its holder, which is a part of the device.

At the start of the game the pointer is set toward the player at the dealer's left. When the score for that hand has been recorded, the new dealer having begun to shuffle, the pencil is returned to the holder by the scorekeeper. This causes the pointer to indicate the person at the left of the new dealer.

The complete outfit includes, in addition to pointer and pencil, containers for two decks of cards.

Scoring the last hand while the new dealer distributes the cards. The memory device is shown resting on the score pad. When the scoring is completed, the pencil is thrust into a socket, causing a pointer to turn toward the player whose turn it is to deal next. The complete device is shown at the right

Modern Uses for Sulphur

SULPHUR formerly was used in matches—the eight-day kind. People got tired waiting for these to burn, so the matchmakers began to leave out the sulphur. Nowadays they use it for vulcanizing rubber and making gunpowder and sulphuric acid. Likewise sulphur is good for killing the bugs on trees, so they put it in sprays.

Where Tunnel Builders Are Boring in Mud under the Hudson

DEEP in the thick mud of the Hudson River's bed, the builders of the great twin vehicular tunnels to connect New York City and New Jersey are advancing foot by foot.

Before the tunnels are completed, early in 1925, millions of tons of mud must be removed, deposited on scows, and dumped in New York harbor.

The work of excavation is performed in a series of compressed-air chambers, each with a higher pressure than the one behind it. High pressure in the foremost chambers prevents the river bed from crushing the tunnel walls and overwhelming the workmen with mud and water.

The intermediate chambers are necessary so that the bodies of the workmen may adjust themselves gradually to the pressure in the last one.

Even against the pressure within, the mud from the great cutting shield enters as shown above. Here it is shoveled into cars which carry it out for disposal.

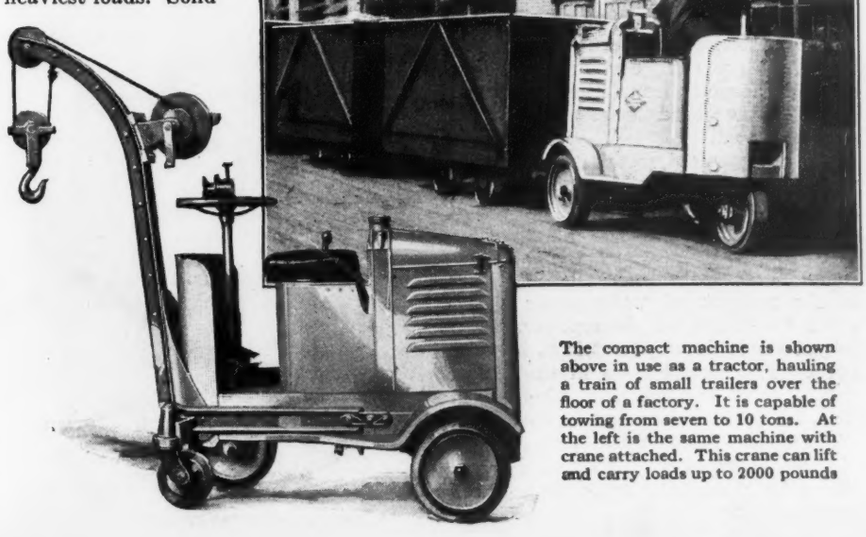
Truck, Tractor, and Mobile Crane Combined

A COMBINED truck, tractor, and mobile crane, so compact that it can enter and turn around in a freight car, has been invented to meet the needs of transportation in such places as shipping yards, warehouses, and large factories. The machine runs on three wheels.

It will tow from seven to 10 tons, or from one to 20 trailers, according to the condition of the floor or yard. The crane is an accessory that can be attached in five minutes. It will lift and carry loads up to 2000 pounds. A brake device permits this load to be carried at any height up to 56 inches.

The 16-inch wheels wear 3½-inch solid tires, providing ample traction under the heaviest loads. Solid equilibrium is given by the 40-inch wheel base and the 33-inch tread.

The machine is particularly useful in loading and unloading box cars, in lifting and towing loads along narrow aisles, and for interplant haulage.



The compact machine is shown above in use as a tractor, hauling a train of small trailers over the floor of a factory. It is capable of towing from seven to 10 tons. At the left is the same machine with crane attached. This crane can lift and carry loads up to 2000 pounds

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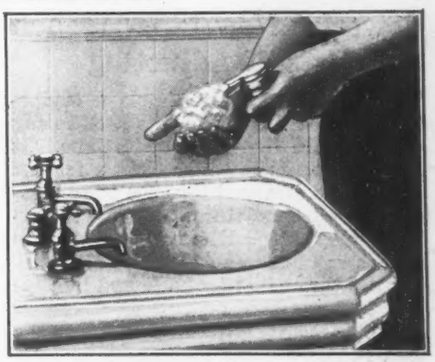
TYPHOID is becoming an almost unknown disease in many American cities, according to a survey by the *Journal of the American Medical Association* of deaths from that cause in cities of more than 100,000.

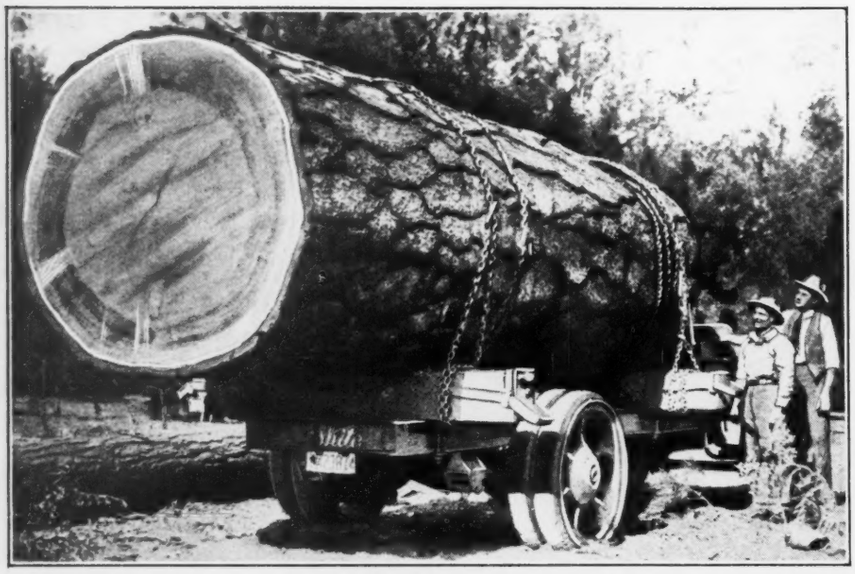


"Lather Gun" Does Work of a Shaving-Brush

SEVERAL handfuls of shaving lather of unusually delicate texture are worked up within 30 seconds from the time a man picks up this new sanitary "lather gun." Because it obviates cup and brush, with their danger of infection, its makers claim that it is particularly valuable for barbers.

Water is poured into a side opening of the device, which contains a soap cartridge. Just enough water for one shave is admitted. A cap on the opening is replaced. Then two easy squeezes of a bulb force out lather through a nozzle in a thick, continuous stream.

Soap cartridges of special size and shape are used. The air from the squeezed bulb drives the water about the soap and into a chamber above. Through tiny holes it enters against curved surfaces, which give it a strong whirling motion. By a series of channels the lather then is forced six times through two fine mesh screens. These screenings achieve the delicate texture of the lather, which is applied by the hands.



Lumber for a Small House in This One Log

NEARLY enough lumber for a small bungalow—8500 board feet—is in this ponderous cut from the body of a California mountain giant.

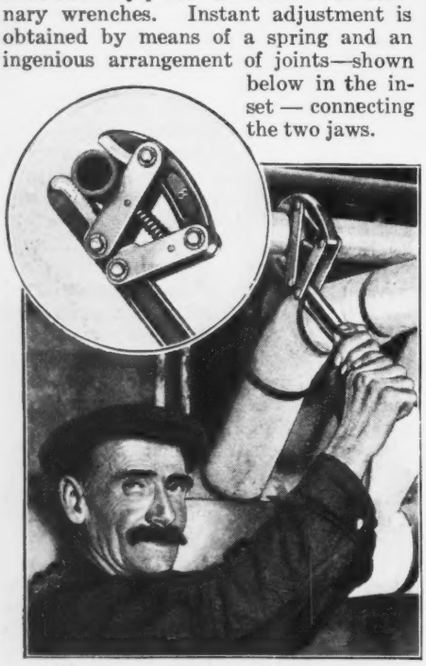
High in the Sierras, where stretch some of the world's richest timber reserves, the great tree was felled by lumberjacks with crosscut saws, toppling at the last urge of wedges and crashing with a roar audible across a valley. Voracious power saws bit it into sections in no more time than was required for the single felling cut.

A truck is shown bearing the huge log to the mill, where sawyers on sliding platforms fashion it into required sizes and shapes.

Powerful New Pipe-Wrench Is Self-Adjusting

THIS powerful but simple new pipe-wrench instantly adjusts itself to any width within the limits of its jaws. It cannot slip, its inventor claims, for the jaws are so arranged that the more pressure placed upon them, the more relentlessly they hold. Because of this, the wrench can be hung on a pipe safely. It will not throw its user backward by slipping during a hard pull.

The manner of gripping permits it to be used in many places inaccessible to ordinary wrenches. Instant adjustment is obtained by means of a spring and an ingenious arrangement of joints—shown below in the inset — connecting the two jaws.



The new pipe-wrench shown in use

Snaky Climb Reduces Grade 13 per Cent

REDUCING a 30-per-cent grade to one of 17 per cent, San Francisco city engineers recently transformed a dangerous hill of Lombard Street in the zigzag manner shown.

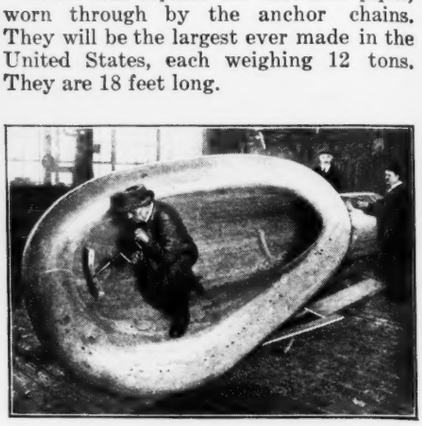
The arrangement, pleasing to the eye, is particularly suited to streets as steeply graded as this one in fine residential districts.

NEW YORK state leads all the others in the amount of water-power development — 1,300,000 horsepower. The largest single development is at Niagara Falls. The second state in the use of "white coal" is California, where more than 1,100,000 horsepower is developed. Washington holds third place, using 454,000 horsepower. Maine is fourth with a few thousand horsepower less, and Montana fifth.

Huge Pattern for Hawse Pipes of "Leviathan"

THE wooden pattern shown below, weighing nearly 1000 pounds, and containing 3000 feet of lumber, will be one of the two used in casting the new steel hawse pipes through which the great steamship *Leviathan's* 12-ton anchors will be controlled.

These will replace old cast-iron pipes, worn through by the anchor chains. They will be the largest ever made in the United States, each weighing 12 tons. They are 18 feet long.



Wooden pattern for giant hawse pipe

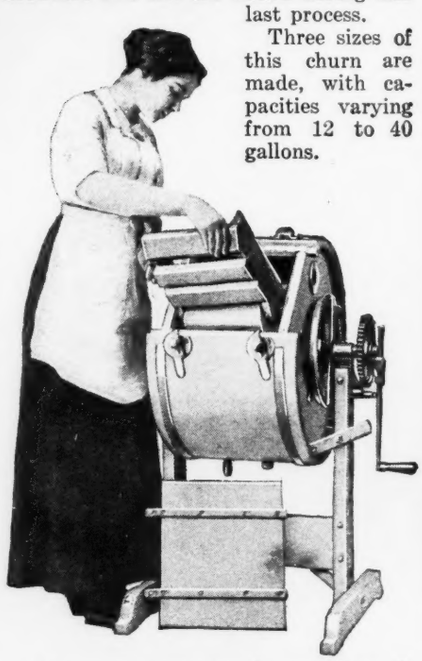
Butter Churned and Worked in 30 Minutes

BUTTER ready to cut in blocks in 30 minutes is the feat claimed for a new combined churn and worker. The fact that no handling is necessary during the process results in greater sanitation than the usual home process.

The new machine is a wooden drum churn with one working roll and one idle roll. The drum revolves with the cream for 15 minutes, either by hand or power. The buttermilk then is drained at the bottom, and warmed water is poured in. A few revolutions wash the butter.

The churn then is thrown into low gear and in 10 minutes the butter is thoroughly worked and ready for the market. Moisture and salt are added during this last process.

Three sizes of this churn are made, with capacities varying from 12 to 40 gallons.

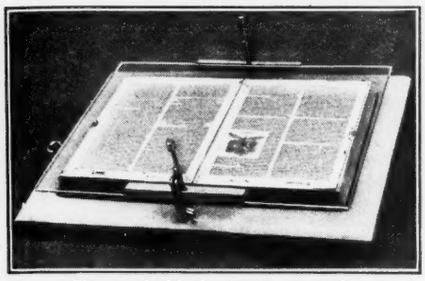


A housewife operating the new churn

Simply Built Frame Aids in Photographing Books

PHOTOGRAPHING pages of a book can be made easy by a simply constructed frame for holding them flat. Especially for a large or a new volume, such a device will save you time and patience.

It consists chiefly of a block of wood 12½ by 16 inches with metal brackets on each side for holding two clamps that flatten the pages. If the page to be photographed is near the front or back of the book, another book or pamphlet should



Clamps hold the book pages flat

be placed under the thinner portion to make the metal brackets fit sungly.

A piece of plate glass is clamped on top of the pages, as tightly as necessary to take out the curve near the stitch of the volume. Three strips of wood should be placed under the clamps to equalize the pressure and prevent the glass from breaking.

The book now can be placed under a vertical camera, or in the horizontal position. Less than a minute will be required to adjust it properly.

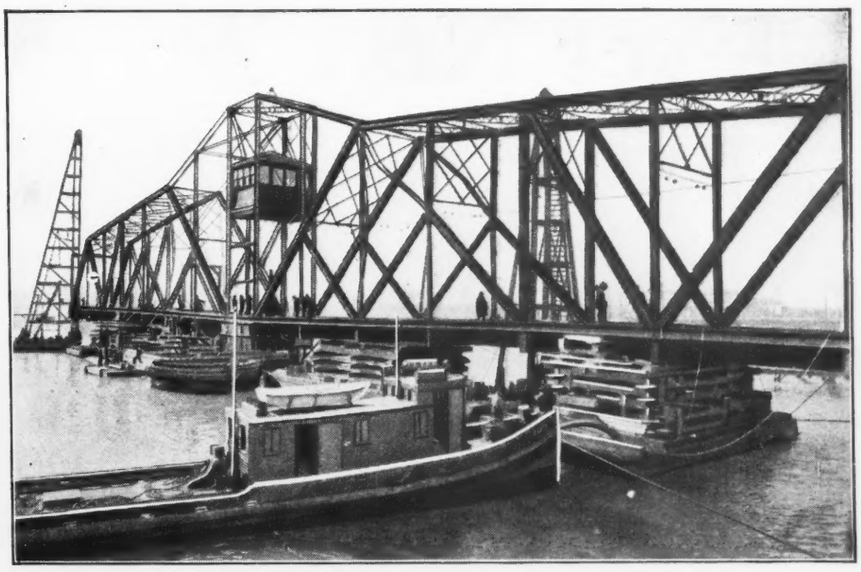
The holder is particularly valuable for copying illustrations, such as maps, which cover two pages.

Cold Sealing-Wax Squeezed from a Tube

GONE seems the day when burned fingers and a scorched envelope often were the price of sealing a letter with wax. For a cold sealing-wax has been developed, one claimed also never to crumble or crack.

You merely squeeze the desired quantity of wax from a tube to the envelope and imprint the seal. Within a few seconds the wax is hardened into a symmetrical seal, made possible by the cold wax.

No heating is required for sealing



Power of Tides Used to Move Old Bridge

THE slow, mighty strength of tides was employed uniquely recently when it was made to lift this old railroad bridge on San Francisco Bay and tow it nearly a mile down the bay. The structure was moved in its entirety in less than a day, without the slightest damage.

Shortly after midnight, at low tide, several hundred men fell quickly to work. A number of barges were floated under the bridge. Toward dawn, the rising tide lifted the ponderous structure from its concrete bulkheads and bore it down the bay.

The photograph above shows the lifted span resting on the barges.

Improved Bicycle Brake Acts against Rim

VERY slight pressure on the brake lever is required to stop bicycles equipped with a recently invented brake consisting of bowed arms that encircle the front wheel and press against the edges of the rim.

These arms are operated by a bow spring, which in turn is connected with a brake rod and operating handles on the handle-bars.

The rim-brake arms are pivotally mounted on clips attached to the front fork of the bicycle. The great leverage minimizes the braking pressure required.

Advertisements Animated by a Coilspring

FOR 25 years advertising men have been seeking a practical method of animating display advertising cards used on streetcars and buses.

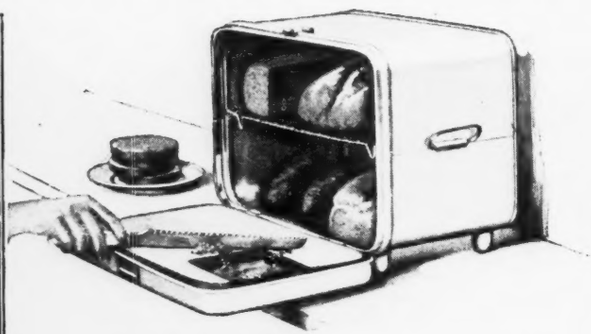
All kinds of mechanical devices have been tried without success, until E. E. Gregory, of Louisville, Ky., who has patented four display advertisement methods, conceived the idea of suspending on a coiled spring any portion of the advertisement that it is desired to animate. The jolting of the car or bus initiates the movement. In this manner the boy's hand in the advertisement shown below is moved up and down rapidly.

The idea now is being used on the Fifth Avenue coaches of New York City.

Road jolts move the boy's hand

Clever New Inventions that

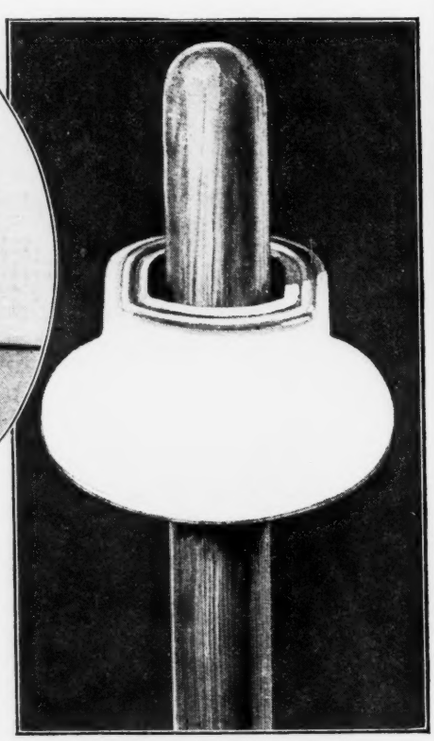
Three different brushes and two handles are included in this new brush set, which can be used to wash windows, sweep carpets, hang pictures or wallpaper, clean the tops of moldings, walls, and ceilings. One handle is for walls, another for floors



"Saving the crumbs" becomes an easy matter for the economical housewife with this roomy and sanitary new bread cabinet. The cover of the cabinet swings downward to form a bread board, at one end of which is a pocket-like container into which crumbs can be scraped

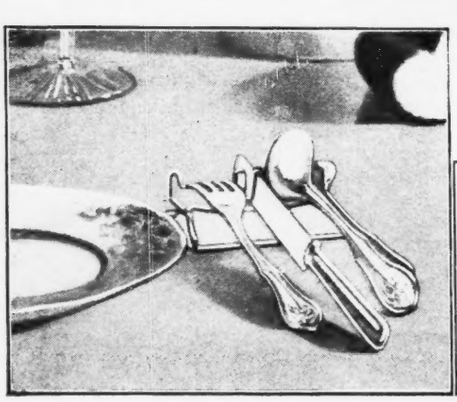
The danger of dirt and disease in ice-water is eliminated by the newly invented vessel shown above, which cools the water while keeping the ice separate from it. The ice is placed in the tubular center container and covered, while the outer container is filled with water

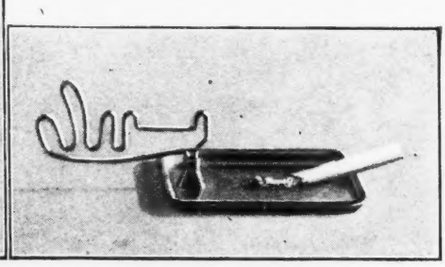
The tedious task of cutting up washing soap is eliminated by this time-saving soap shaver. Rubbing a cake of soap across the device a few times is said to provide enough shavings for a large washing



One of the simplest broom holders imaginable is this bent piece of metal fastened to the wall. The broom handle is inserted through the hole from the bottom, and the plate pinches it against the wall

A baby in the arms becomes a heavy load after a few minutes. To relieve parents of this burden a French inventor had devised the simple, yet convenient carrier shown above. A strip of canvas in which the child rests terminates in two handles, one on each side. Guards at the front and rear keep the baby from falling out





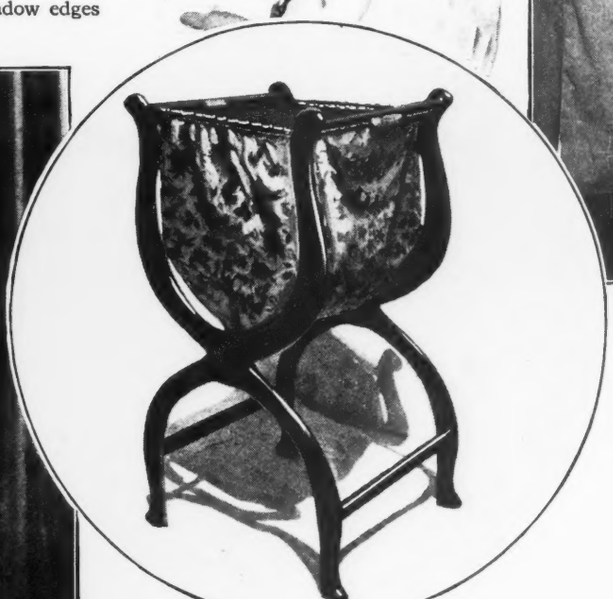
This ingenious little tray for the table serves a double purpose—as a rack for the knife, fork, and spoon, and as an after-dinner ashtray, to obviate ash-spilling on greasy plates. For the latter purpose the rack is turned aside in its socket

Make Housework a Pleasure

Numerous small cleaning jobs about the house and garage are accomplished neatly with the little implement shown above—a double-edged blade of specially molded rubber attached to a short wooden handle. The lower, curved edge is used for scraping pots and pans, while the straight edge, for cleaning windows, gathers all the moisture and dirt from the window edges

Objectionable odors of cooking and discoloration of kitchen walls by grease are said to be eliminated by a new filtering flue designed to fit the vent of any gas oven, as illustrated above. The device can be attached in a minute without tools, the manufacturers say

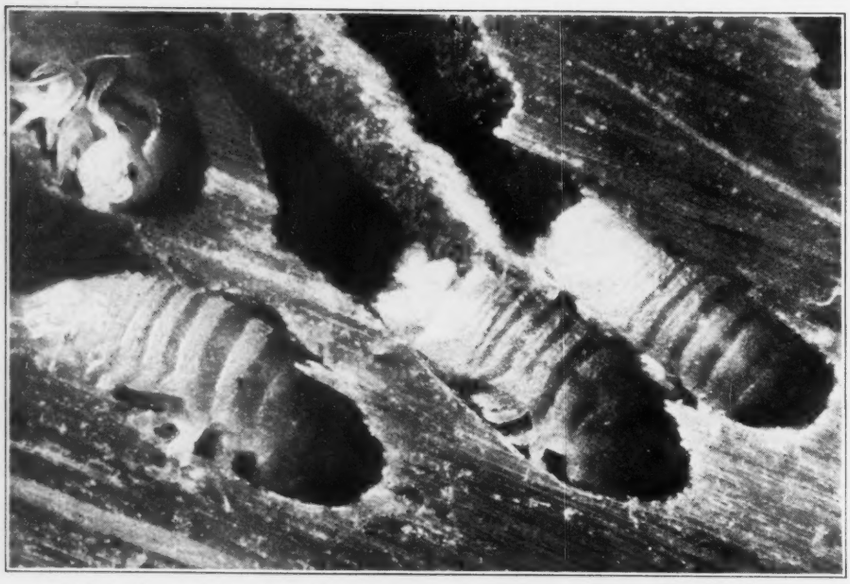
In this 7½-pound vacuum cleaner, the bag and motor are concealed in the aluminum housing on the floor



This attractive sewing-basket stand folds to half its width. Numerous compartments within the bag hold the sewing materials

The odd cover of this new glass jar for jam or pickles has been invented to protect the contents from dust and contamination. The cover incloses the end of the preserve spoon

The capacity of a closet is said to be greatly increased if the clothes are hung from the seven-to-the-bar hooks shown above. Suits and gowns on hangers can be arranged in space-saving rows. The hooks are useful also for hanging kitchen utensils, dustcloths and brushes, or for holding tools in the workshop



Marine Pests Bore into Creosoted Piling

WOOD in general, and valuable piling along waterfronts in particular, are the favorite delicacies of these destructive wood-boring marine pests, scientifically called "*Limnoria*." Against them the resources of the United States Forest Service's Forest Products Laboratory are being marshaled.

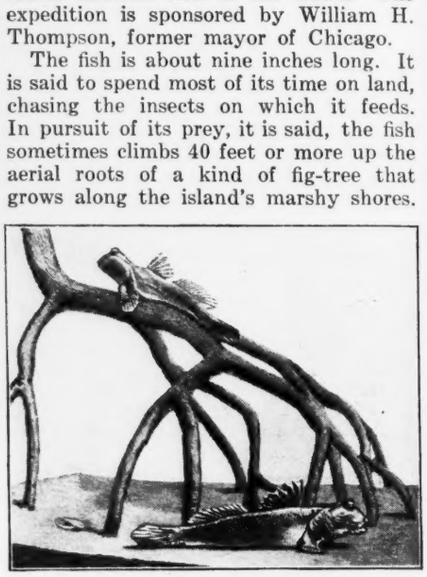
These tiny creatures, the largest never more than a quarter of an inch long (those shown above are highly magnified), are a serious problem on both the Atlantic and Pacific coasts. Coming in contact with piling through the chance of tide or drift, and lodging in a crevice or on the surface, they eat away the soft wood, leaving the remainder in riblike ridges. After a time a pile may snap in two.

Limnoria are harder to combat than are other marine pests with a taste for wood, because they will penetrate wood impregnated with creosote.

Odd Tree-Climbing Fish Can Jump Six Inches

A MOTION-PICTURE expedition soon will leave for Ceram, an island of the Malay Archipelago, to make films of a remarkable tree-climbing fish that is found nowhere else in the world. The expedition is sponsored by William H. Thompson, former mayor of Chicago.

The fish is about nine inches long. It is said to spend most of its time on land, chasing the insects on which it feeds. In pursuit of its prey, it is said, the fish sometimes climbs 40 feet or more up the aerial roots of a kind of fig-tree that grows along the island's marshy shores.



These fishes climb with leglike fins

It lives in a burrow in the muddy shallows.

It climbs with a pair of ventral fins, suggesting legs, and highly developed pectoral fins, like arms. Its usual way of covering ground, however, is jumping. It can jump about six inches.

Tiny gill-slits, conserving moisture, allow the fish to stay out of water.

Leafless, Branchless Tree

DURING a recent exploring expedition into the desert mountains of Sonora, Mexico, Dr. D. T. MacDougal, of the Carnegie Institution's Laboratory of Plant Physiology, Tucson, Ariz., discovered the strange leafless and branchless tree shown above. He believes the members of his party were the first white men to see this remarkable evergreen.

The trunk, resembling an almost bare column, is of soft, pithy growth. The only features resembling limbs are the slender spines that bristle from the trunk.

PERSIMMONS are scheduled to rise in popularity. At last a persimmon that will not pucker the mouth has been found. It is the Fuyu persimmon, which comes from Japan.

U. S. Imports Giant Rivals of the Potato

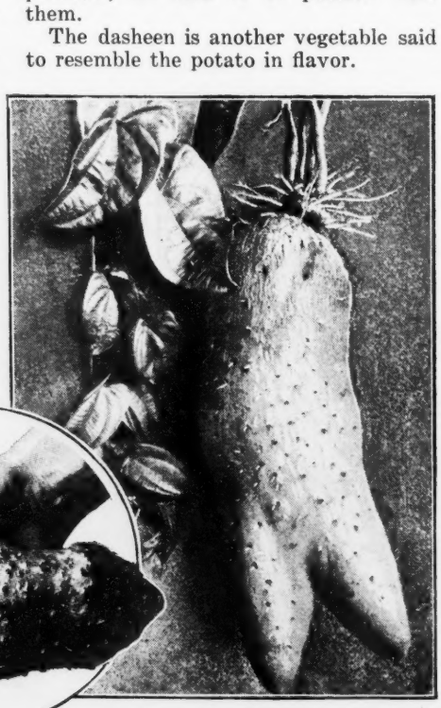
YAMS, some species of which are said to be as high in food value and as palatable as white potatoes, although weighing up to eight pounds, soon may be enlarging the nation's food supply. Uncle Sam's Plant Bureau has imported a number of species from the West Indies and is experimenting with their cultivation.

These tubers give enormous yields to the acre. The bureau's experts now believe that they can be grown in California, in the Gulf states and as far north as Charleston, S. C. They are said to taste much like white potatoes.

In tropical countries they supply much of the food of millions of persons. Yams weighing 100 pounds can be grown, but from three to eight pounds seems the most desirable weight.

The yams may be baked or boiled, and a variety of dishes approximately equal to the number that can be made from potatoes, are said to be possible with them.

The dasheen is another vegetable said to resemble the potato in flavor.



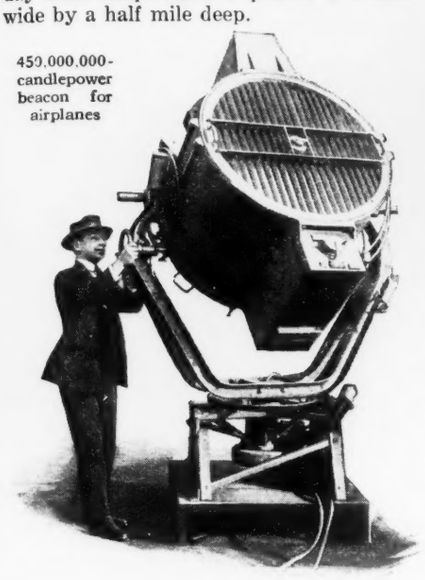
Small yam, grown in central Florida

The "greater yam," grown in South Atlantic and Gulf states regions

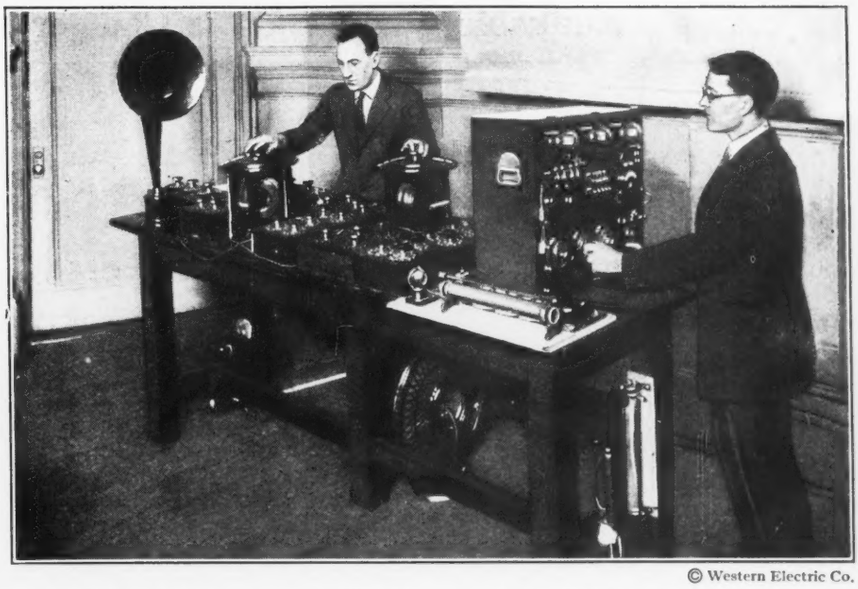
Powerful Beacons to Guide Aviators at Night

POWERFUL 450,000,000 candlepower eyes like this one are to gleam through darkness, fog, and storm from government landing-fields to guide aviators to safety. Its mighty beam is said to be visible for 130 miles through ordinary darkness.

The searchlight beacon is equipped with a dispersion lens that, if directed along the ground, is said to make as light as day a fan-shaped area a quarter of a mile wide by a half mile deep.



450,000,000-candlepower beacon for airplanes



© Western Electric Co.

A Machine that Talks with Electric Voice

THIS machine talks—not as a phonograph talks, by reproducing a recorded voice—but with a voice of its own. It is not a highly educated machine, for its sound repertoire is limited to the vowels and to a few simple combinations with consonants. For example, it is said to utter "Mama" and "Papa" plaintively.

Its artificial voice speaks when vibrations from a vacuum tube oscillator are fed into an overloaded vacuum tube. Two tuned circuits are coupled to the output and the resulting complex sound is fed into a loudspeaker. The voice is closely related to the howls and squeaks that sometimes issue from a radio receiving set.

The photograph shows the machine in the laboratories of the Western Electric Company.

Workmen's Efficiency Analyzed by Movies

TO LEARN why some workmen accomplish more than their fellows with less effort, motion-picture films of men at work are analyzed on the ingenious drafting table shown below.

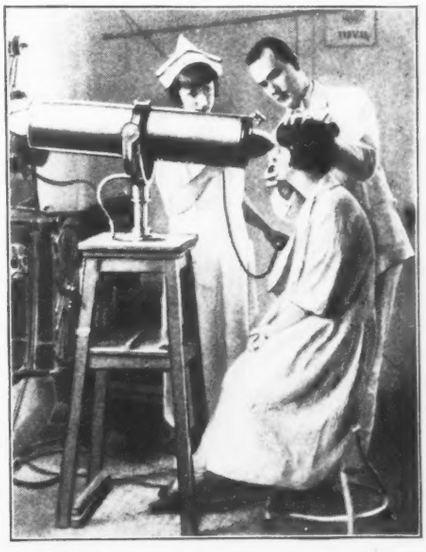
The films are not projected, but studied directly on the roll. They are run through a cabinet shown at the left of the table. A strong light within the cabinet brings out the minutest details of each picture. A slit down the face of the cabinet, through which the pictures are seen, allows about 25 to be visible at a time. These are studied one by one, painstakingly, with a magnifying glass.

The drafting paper, on a continuous roll, is ruled horizontally and perpendicularly. The horizontal lines indicate units of time—2000 to a minute; the perpendicular lines represent those parts of the laborer's body involved in the work.

Thus graph lines, rising and falling with the slightest changes in the time required for the various movements making up the work, and moving to right and left as the parts of the body move with the work, present a minutely detailed story of the workman's movements.

These movements then are criticized with a view to further elimination of waste motion and time.

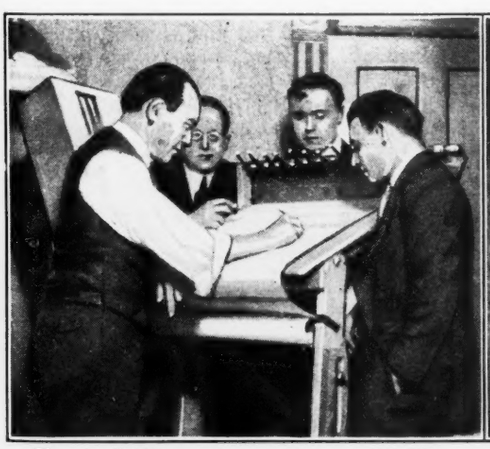
ENGLAND now has the first lighthouse for automobiles. It has been erected on a dangerous hill between Birmingham and Manchester to guide motorists at night.



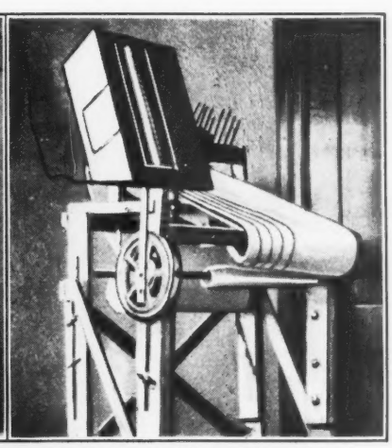
Magnet Removes Steel from Patient's Eye

INSTEAD of surgery, a powerful magnet was used recently to remove a piece of steel embedded in a woman's eye. Dr. D. T. Vail, of the Massachusetts Eye and Ear Infirmary, is shown above operating the magnet, which is so powerful that it could lift a solid steel table. Placed with its tip close to the patient's eye, it quickly drew the deeply embedded bit of steel to the surface of the eyeball.

Many valuable uses are predicted for this magnet, and for more powerful ones that may be built. Operations for removal of foreign objects from delicate organs, such as the brain or the heart, can be made safer and less painful by its use, it is said.



Charting bodily movements shown on the film



The drafting table and film cabinet

A Light, Unsinkable Canoe for the Camper

This canoe can be carried by a boy — and it won't sink

THIS 30-pound, unsinkable canoe, constructed of cypress, makes a splendid sport easier to follow, simplifying the problem of portage and minimizing danger of accident. A boy can carry it.

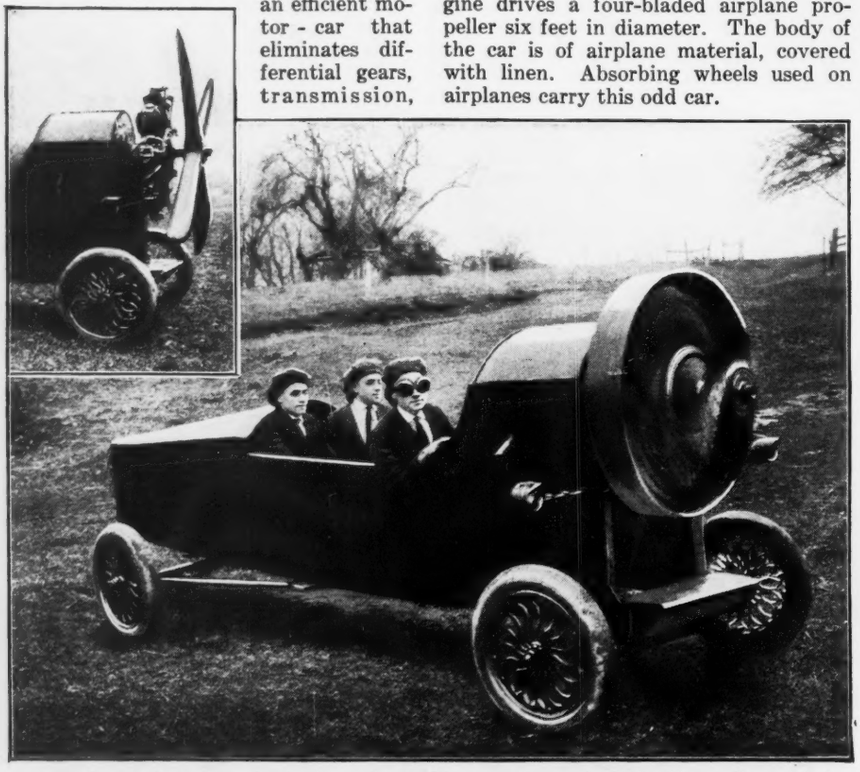
Although the midget craft will hold two persons, any considerable cargo of supplies would limit it to one passenger. Its lightness makes it easy to paddle and easy to carry.

Watertight bulkheads at each end make it unsinkable. The canoe is especially suited to the needs of youngsters learning to be waterwise. It can be lashed easily to the runningboard of a car.

Airplane Propeller Drives Odd Motor-Car

DRIVING an automobile with an airplane propeller at a top speed of 90 miles an hour, Harry and Martin Sensenich, of Lititz, Pa., claim to have developed an efficient motor-car that eliminates differential gears, transmission, and jerk in starting. They assert that its gasoline consumption is no greater than that of any other car of similar power.

An 80-horsepower rotary airplane engine drives a four-bladed airplane propeller six feet in diameter. The body of the car is of airplane material, covered with linen. Absorbing wheels used on airplanes carry this odd car.

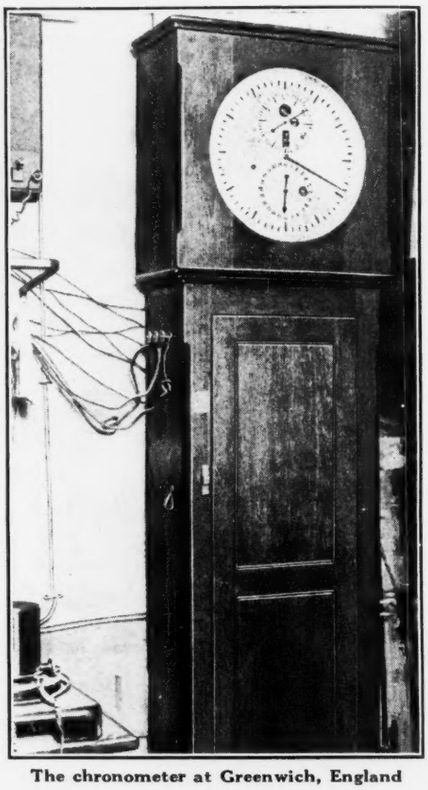


An airplane propeller in front drives this car at a speed of 90 miles an hour

Greenwich Clock Records Birth of Each New Day

THE world's most important timepiece is the chronometer, pictured below, in the Royal Observatory, at Greenwich, England. It officially records Greenwich meridian time. There the birth of each new day is recorded for the world, for there it is midnight before it is midnight anywhere else on earth.

Henceforth, this time is to be broadcast from the observatory at regular intervals. Thus English radio enthusiasts may keep their watches and clocks precisely right, ready to hail each new day at the exact moment of its birth.



The chronometer at Greenwich, England

They'll See Us in Movies in the Year 6924

PEOPLE who inhabit the earth 5000 years from now are going to have a chance to look back through the centuries and see just how we ran our industries and manufactured our products in the year 1924. And they won't have to decipher inscriptions, nor make conjectures to learn how far their civilization has progressed.

They will see us in the movies!

The possibility that motion pictures of 1924 workmanship can be handed down through the ages comes through the work of Watterson R. Rothhacker of Chicago, Ill., who has developed a preserving process to the point where he is ready to store—in the Smithsonian Institution at Washington, D. C.—history's first collection of movie films. The films will be sealed in a preserving vault, with a stipulation by Mr. Rothhacker that it remain sealed for 5000 years.

Scenes from rolling mills, steel mills, engine factories, and machine shops will be included in the collection.

Hudson Maxim Still Young and Vigorous at 71

ASIDE from whitening his patriarchal hair and beard, and thickening a little more his stocky frame, old age has left few marks on Hudson Maxim, famous inventor of explosives.

At 71, he punches the bag and pulls the weights like a youngster training against the day when he may topple a champion. Vigorous, sound of body, and in love with life more than ever, he contradicts the theory that men who cram each day with activity and achievement thereby shorten their lives.

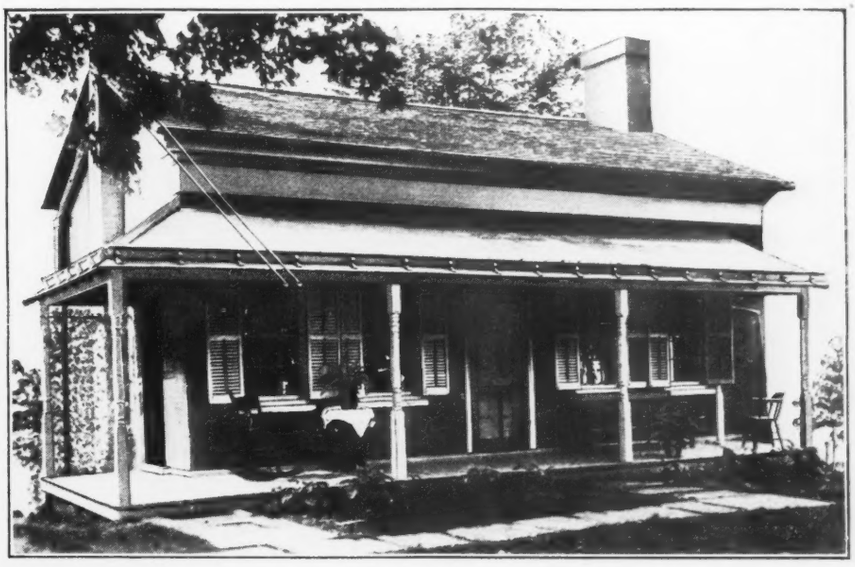
At his beautiful home on Lake Hopatcong, N. J., with his wife, he has settled down to enjoy the rest of life. Responsibilities thrown aside, he does whatever he wants to, with the zest of a boy suddenly showered with good things, but with the keener enjoyment of one who has struggled for them.

Hudson Maxim at his daily exercise

Genial and young-spirited, he is the idol of the neighborhood children. Each year he takes delight in playing the part of King Neptune in the Atlantic City beauty contest. He also enjoys mental combat over a chessboard.

THROUGH its destruction of cotton, the boll weevil's bill to the average American family is $50 a year, and there is little prospect of cutting down this loss, says W. E. Hinds, of the Alabama Experiment Station.

Edison's Birthplace Discards the Oil Lamp



THE little brick house in the village of Milan, Ohio, in which Thomas A. Edison was born 77 years ago, recently was lighted by electricity for the first time. For a century the kerosene lamp, driven from nearly every American home by the great electrical wizard, has held full sway.

The house is owned by Mr. Edison and is occupied by a relative of his.

Midget Engine Drives Model Speed Boat

A FOUR-CYLINDER, 43-ounce steam engine, generating one-quarter horsepower at 3500 revolutions a minute, drives the 42-inch model boat shown below at the remarkable speed of from 10 to 12 miles an hour. Boat and engine are the work of Horace E. Boucher, of New York City.

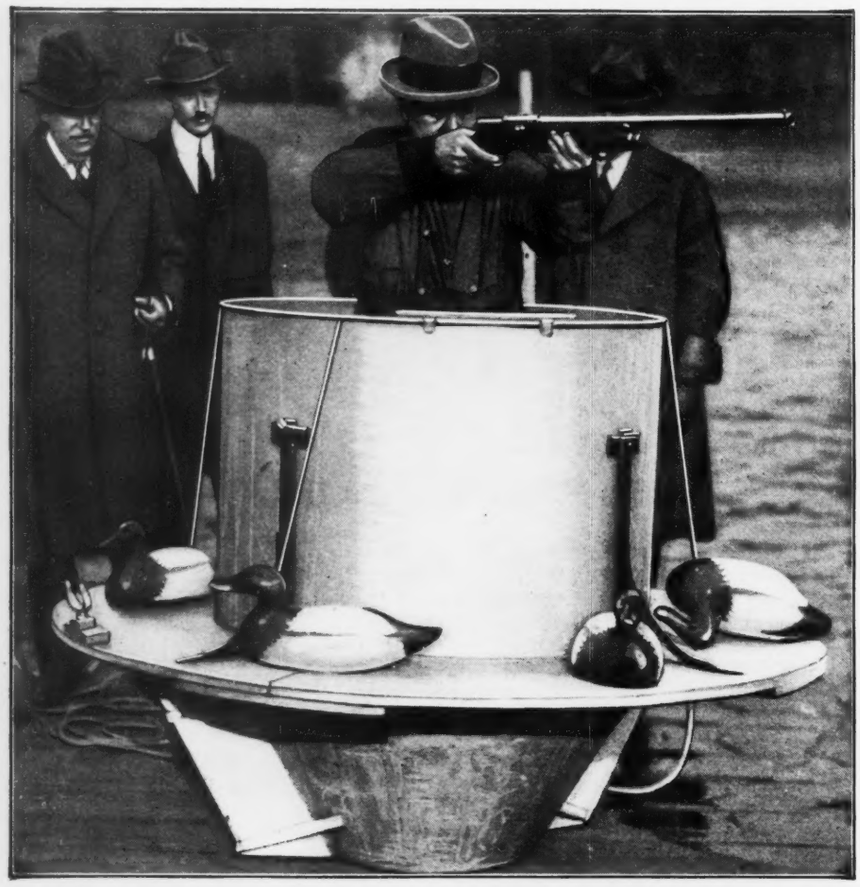
The tiny craft is built stoutly of three-ply birch veneer, mahogany-trimmed. She has twin screws, and racing lines modeled after some of the world's fastest boats. She is 42 inches over all, with a beam of 9¾ inches and a draft of 5½ inches.

The maker also has perfected single- and double-cylinder midget engines. The former weighs 10 ounces and the latter 32 ounces. When either of these is used, only a single screw drives the craft.

The boiler for the four-cylinder engine is tested to 250 pounds pressure and the safety valve is set to blow off at 80 pounds. The bore and stroke are ¾ by ¾ and the engine is 8¼ inches long.

Horace E. Boucher with his 42-inch steam-driven boat. Above: Midget steam engines

Unsinkable Life Raft Serves as a Duck Blind



When afloat, the duck blind draws water up to the shelf holding the decoys

COMPACT and comfortable, this combination duck blind and life raft, invented by Dr. Charles Hunt, of Washington, D. C., enables a hunter to make easy use of the most favorable locations, requiring only a tow there and a tow back. It cannot sink or capsize, its designer claims.

Resting on a seat inside, the hunter can wait in comfort for his game, while about his odd craft, tethered by strings, floats his flock of decoys. The raft floats at the level of the circular shelf, upon which the decoys are shown. A small heater can be carried inside.

An Ocean Sulphur Spring

BUBBLING out of the ocean from a depth of 125 feet, a big spring of fresh sulphur water, two miles off the coast of Florida, near St. Augustine, recently was surveyed by experts of the U. S. Coast and Geodetic Survey.

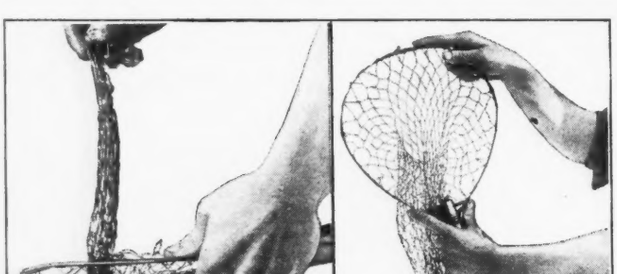
The government scientists anchored directly over the troubled waters of the sea spring. The water sampled was about the same temperature as the surrounding Atlantic, but the tremendous size and force of its geyser-like upwelling was plainly apparent at the surface.

An Automatic Landing Net for Fishermen

ONE of the handy new inventions for the fishing season is a collapsible, automatic landing net that folds in a compact case. When not in use, the fisherman can hang it on his belt, where it is instantly available.

Simply pressing a button on the case causes the net to spring out and open. It can be folded in 10 seconds. A portion of the hoop opposite the handle folds in and the netting is wrapped about the two parts thus formed.

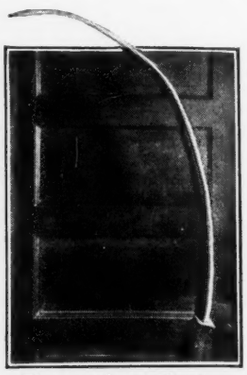
Folded, the net is 13 inches long, 1½ inches in diameter and weighs but 13 ounces. When open, it is 12 inches long and 9½ inches wide.



Wrapping the net on the frame — The net ready for use

Limb of Spruce Indicates Changes in Weather

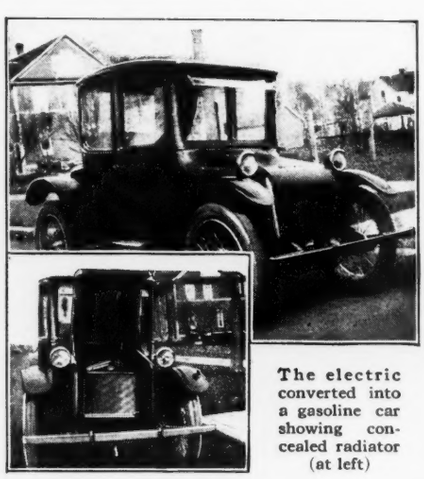
A PEELED spruce limb, attached to the door of an office in the U. S. Forest Service's Forest Products Laboratory at Madison, Wis., indicates humidity changes with very nearly the accuracy of a scientific instrument.



The weather indicator

During the months when artificial heat is used, it bends far to the left. During the warmer months, when the windows are open and the air of the room is moister, it becomes nearly upright. These changes cause its tip to move through a distance of 30 inches, describing an arc of about 80 degrees. Dates indicated on a chart along this arc show its position at different times of the year.

This remarkable action arises from the presence of compression wood along what originally was its under side. Compression wood is found on the under side of limbs and on the lower side of leaning trunks of all cone-producing trees. It is the action of this wood that causes the limbs of standing dead trees to curve down during protracted dry weather. Moist weather swells the compression wood, straightening the limbs.



The electric converted into a gasoline car showing concealed radiator (at left)

Electric Car Now Uses Gas

WHEN an electric automobile, practically new, was condemned to the junkman recently because of the cost of batteries, an inventive mechanic in a southern Minnesota city conceived the idea of replacing the electric motor with a gasoline motor from a small, popular-priced automobile. The result is said to be entirely satisfactory.

The frame and differential of the original electric were used. The steering lever was not changed. Although the car weighs 2300 pounds, the engine drives it easily, at a speed of from eight to 35 miles an hour.

New Garden Tool Performs Three Operations

A WEEDER, a mulcher, and a cultivator are combined in a new hand-pushed garden implement resembling a lawnmower in appearance and operation. Its triple function and the rapidity with which it works are said to lessen labor greatly.

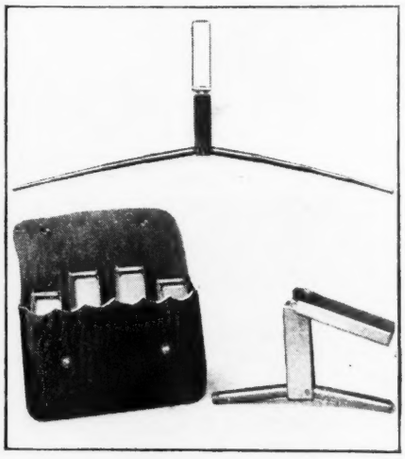
Weeder and cultivator

Eight blades, set in revolving reel heads, revolve against a stationary knife. This knife, slightly behind the blades, travels just below the surface of the soil, cutting the weeds at their roots. The revolving blades destroy any weeds that escape, pulverize the clods, and aerate the soil.

Between the blades and the knife is a five-eighth-inch space. The granulated top crust pours evenly over the knife through this, leaving a level mulch.

The cultivator attachment need not be used when only shallow cultivation is desired. When not in use, it rides on top.

Collapsible Coat-Hangers Fit in Pocket Case



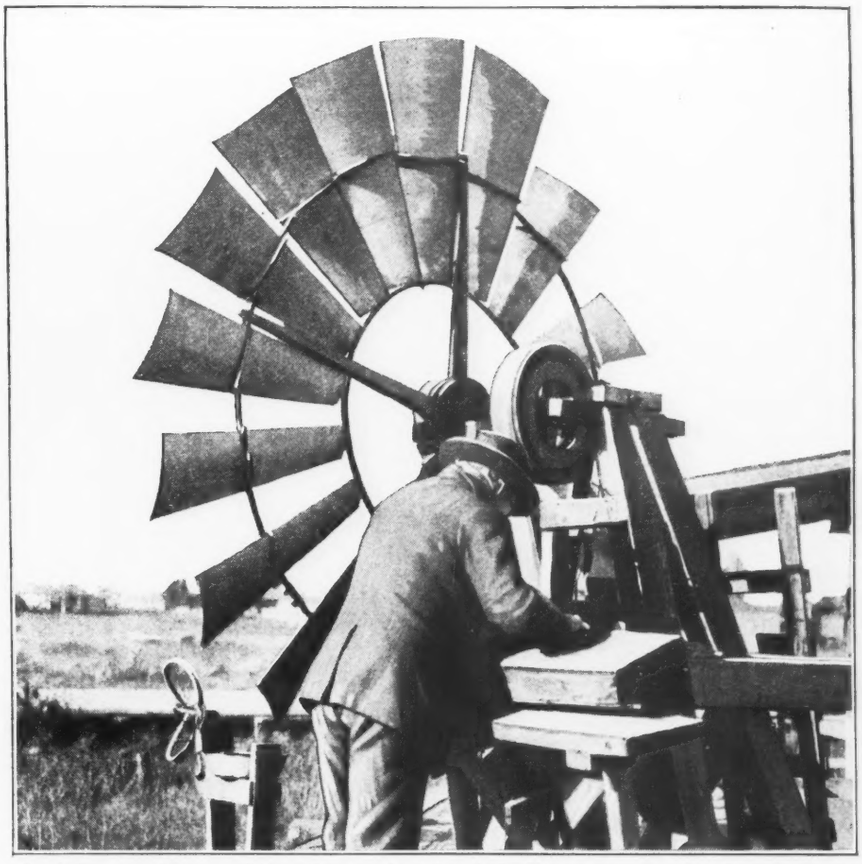
SIX of these new collapsible nickel-plated coat-hangers, in a small leather case, can be carried in a man's hip pocket. Cases containing one, two, three, or four hangers also are available. They are especially useful for travelers and campers.

Closed, each hanger measures $2\frac{3}{4}$ inches by three-quarters of an inch. Each has a 16-inch spread when expanded.

The hanger collapses by telescoping. The telescoped arms then fold within a two-sided frame. A second frame then folds, closing the other two sides of the first frame and locking the telescoped arms in place.

The illustration shows how the hanger telescopes, folds, and fits in the small, neat leatheroid case.

This Sailor Makes the Wind Saw His Wood



Louis Brotten, 86 years old, cutting wood at the windmill saw he invented and constructed

AFTER years at sea, many of them on sailing-ships, coaxing lazy winds, Louis Brotten, of Bay Farm Island, near Alameda, Calif., finds it a simple task to make the winds saw his wood.

At the age of 86, he earns his living by turning the breezes to work, standing before his windmill saw whenever and as long as a stout enough blow is on.

The saw is his own invention. He built the machinery himself, working out the right angle for the vanes. A belt from the windmill shaft runs the saw.

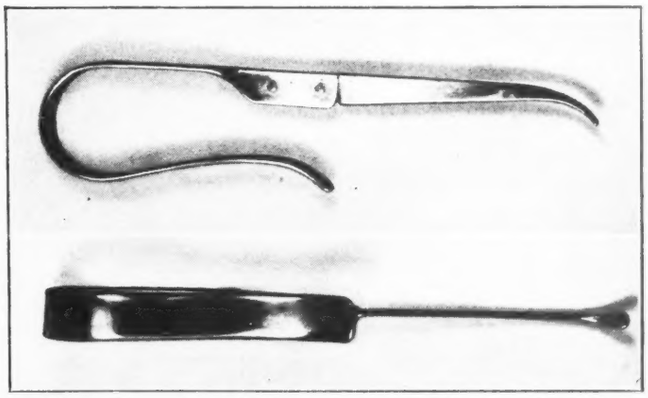
What Goes Up the Chimney

EVERY time a ton of coal is burned in the family furnace, 17 tons of gas go up the chimney. Of these tons, 16 are gases of the atmosphere. More than 12 are of nitrogen. Nearly four tons of oxygen used in burning the coal go up as carbon dioxid, sulphur dioxid, and water vapor. Most of the coal—about 1500 pounds or so—also goes up the chimney as carbon dioxid. Less than one part in 100 forms smoke.

A Handy New Tool for Opening Wrappers

OPENING the wrapper of a magazine without tearing the magazine has been facilitated by the invention of an ingenious cutter, approved by the United States Post Office Department.

The device also handily cuts string on packages.



Side and top views of the wrapper cutter, showing the blade

The tool has a curved blade with a thin, flattened tip. The latter is inserted under the wrapper, slitting it up neatly. The handle is a sort of hook, that enables the user to keep the blade quite flat against the magazine or package.

The cutter is the invention of Arthur Hoffman, a rural mail-carrier of Howard, Neb.

World's Greatest Powder Blast Tears Away a Hillside

Above: The 275-foot hillside near Lakeside, Utah, before the great blast was set off. More than 150 tons of special powder was used

MORE than 150 tons of especially powerful blasting powder, said to be the largest charge ever set off for commercial purposes, recently tore away a hill 275 feet high with a 1000-foot face, near Lakeside, Utah. More than a half million tons of rock shot upward with a mighty roar and scattered over 40,000 square yards of ground.

The entire population of Lakeside joined with railroad and blasting engineers from all parts of the country in witnessing the spectacle from a hillside more than a mile away.

Seven months were required to prepare the hill for the great blast, which was set off by the Southern Pacific Railroad to obtain rock for building up the fills approaching the company's trestle across the Great Salt Lake. More than enough material for the entire construction work was obtained from the hill.

Six tunnels, each from 100 to 150 feet deep, aggregating 4100 feet in length, were bored. These were loaded with the 150 tons of special powder, said to be as powerful as 250 tons of ordinary blasting powder.

The explosion. Half a million tons of rock shot upward and scattered over 40,000 square yards of ground. At the right is shown the great hole torn in the hillside by the force of the blast, which was one of the largest blasting charges ever set off

Monoplane with Revolving Wings Designed to Fly Straight Upward

A HELICOPTER closely resembling a monoplane, and acting as one, except when vertical flight is desired, has been invented by Russell Halligan, of Beardstown, Ill.

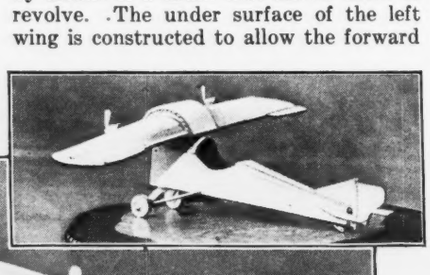
The machine, which so far exists only as a model, is designed on the following principles:

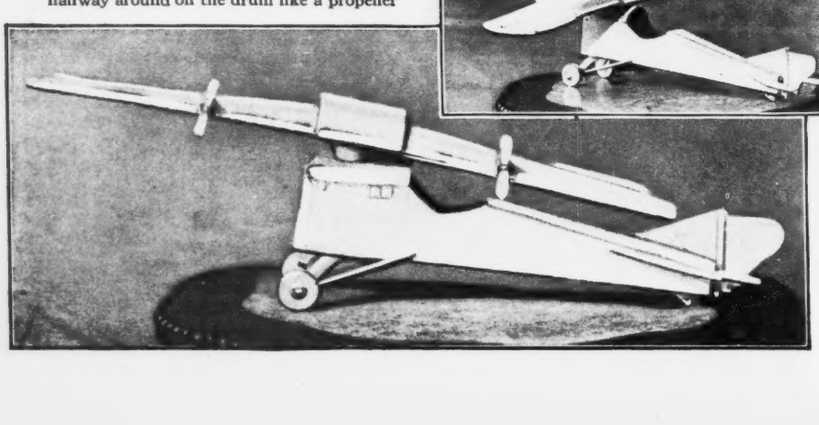
The wings are attached to the fuselage by means of a drum that allows them to revolve. The under surface of the left wing is constructed to allow the forward edge to be lowered by controls in the cockpit. Thus the pitch of the left wing can be altered, causing the wings to become a large propeller.

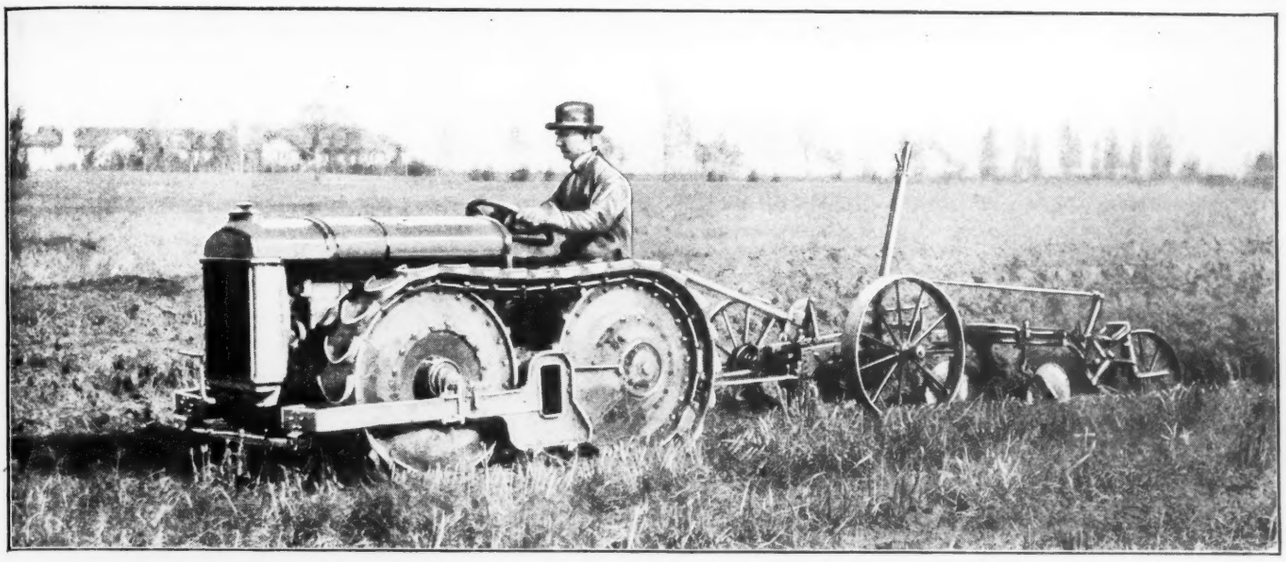
The motors, in the wings, drive two propellers, one on the forward edge of each wing. Since the motor in the left wing can be reversed, these two propellers cause the wings to revolve. When they revolve at a speed sufficient to counteract the air resistance on the wings, the plane, it is claimed, will rise vertically, in the manner of a helicopter.

When the desired height is reached, the wings will be locked in a monoplane position by a contracting brake on the drum. The pitch of the left wing then will be restored to normal, and the left motor again reversed. The plane then will be sent into a glide, to gather speed. When a flying speed has been attained by this means and by the propellers, the plane will fly as does any monoplane, the inventor asserts. In landing, these operations would be reversed.

The view of the model helicopter-monoplane at the right shows the wings set for gliding flight. Below, the wings have been swung halfway around on the drum like a propeller







Odd "Crawlers" Invented to Double a Tractor's Pulling Power

A FORDSON tractor is said to deliver twice its usual power at the drawbar when the wheels are shod with a pair of newly invented continuous-tread crawlers. This increased power results, it is claimed, from a change in gear ratio and the elimination of the old waster, traction slippage.

Since 1000 square inches of traction area is in contact with the ground at all times, the pressure of the tractor upon the ground is said to be only 3½ pounds to the square inch, far less than the pressure of a horse's hoof. Thus a tractor equipped with the new treads is built to operate on ground so soft that neither horses nor tractors with ordinary wheels could work it.

In field tests the invention is said to have enabled a tractor to pull three 14-inch plows, at a depth of 7½ inches, over a footing so poor that an ordinary tractor barely could pull two such plows.

The control is unique. Square turning, without strain on the differential, is made possible by two independent clutches. The clutch on the inside track is released, while the other remains engaged. Thus the inside track stands still while the outer one moves at normal speed, not at double speed as it would if working through the differential.

A liberal range of up-and-down track oscillation permits riding over rough ground without losing traction efficiency or throwing undue strain on the tractor frame.

This Fishing Engine Pulls in the Big Ones

HAULING in halibut by hand is a difficult job, even for a Gloucester fisherman. For this reason a fishing engine recently has been invented to do the heavy work of bringing a 25-pound, struggling fish, a heavy deep-sea lead, and many fathoms of wet line over the side without any muscular effort.

The device is driven by a belt from the propeller shaft of the boat. As the fishline comes over the gunwale, it first passes through two rolls that prevent it from tangling, around a winding wheel, and then between two smooth gripes held together by a tension spring.

Varying the tension of this spring makes the machine pull strongly or lightly, as is desired, so that it can be used to catch anything from cod to a young shark.

A revolving line-tub keeps the fishline from becoming snarled. All the fisherman has to do when he feels a bite is to start the engine.

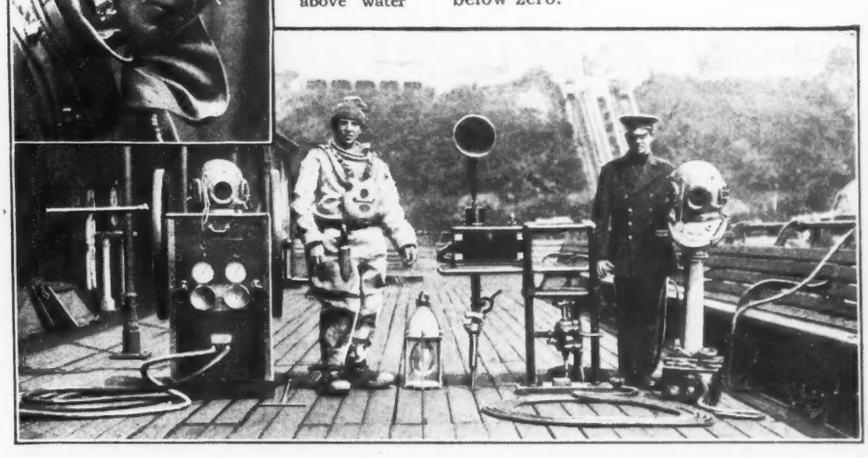
Divers Now Can Telephone from the Depths

WORDS transmitted not by the voice itself but by external movements of the throat now are being used by divers to communicate over a telephone line with those above.

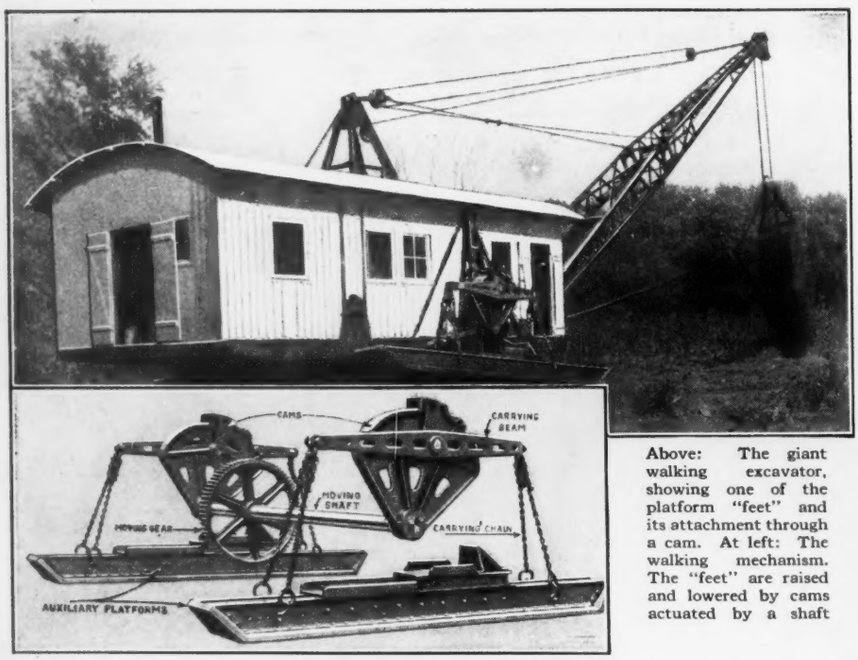
An ordinary microphone allows the diver to hear from above, but heretofore, communication by a diver, except by pulls on the life line, has been next to impossible. Noises produced by the pumping of air to him have drowned his voice. Yet such communication always is desirable and often vital to his safety.

The new device, the "laryngaphone," is held in tight contact with his throat, as shown in the photograph. Thus every throat movement, as transmitted to those above, is transformed into the sounds of a voice, reproduced with perfect clearness, yet unaffected by the noise of pumping operations.

The transmitting device in position about the throat. Below, the receiving apparatus above water



AT THE highest point reached by man, about 6½ miles, the air pressure is less than a fourth of what it is on earth, and the average temperature is 50 degrees below zero.



Above: The giant walking excavator, showing one of the platform "feet" and its attachment through a cam. At left: The walking mechanism. The "feet" are raised and lowered by cams actuated by a shaft

Walking Excavator Hikes 30 Feet a Minute

THIS giant excavator walks—walks up and down steep grades, over rough ground, and around obstructions. It will walk about three miles in 10 hours, its builders claim, consuming 45 gallons of gasoline or distillate and less than two gallons of oil. It covers 30 feet a minute and is operated by one man, with one lever.

The remarkable machine is said to be revolutionizing methods of constructing drainage canals and levees, enormously reducing costs, and opening projects hitherto not considered feasible. With a gang of four or five men, it is claimed to do the work of hundreds of men with teams.

The walking "feet" of the machine are two auxiliary platforms, one on each side, acting through ingenious cams.

When the machine is to walk, a pinion clutch is engaged and the engine started, setting a camshaft in rotation. As this revolves, the cams lift the auxiliary platforms and swing them forward until they again are returned to the ground by the cam movement.

As the shaft continues to rotate and while the platforms are in contact with the ground, the cams slide along the tread plates on the tops of the auxiliary platforms. Thus the rear end of the machine gradually is raised from the ground. Finally, the cams come in contact with stop blocks on the platforms. They cease sliding and move the machine forward, lowering it to the ground.

The excavator rests upon a large flat base while working, reducing vibration.

How Much Science Do You Know?

EVERY day your actions are affected by your knowledge of scientific facts. You avoid drafts because you know they cause colds. You avoid live wires because you know they are dangerous.

But once you knew neither of these facts. Similarly, you still have hundreds of vital facts to learn, facts that will help you guard yourself, enable you to recognize opportunities, and save you wasted effort. Some will help in small matters, some in great matters.

The answers to five of the 12 questions below offer you useful facts of this kind. Which questions are they?

The correct answers to all the questions appear on page 134. But don't look until you've tested your knowledge first by trying to answer them yourself.

1. Could a balloon keep on going up forever?
2. Why do not ferns grow well in the house?
3. Why do cats' eyes shine in the dark?
4. How many stars can we see?
5. Do dreams ever foretell the future?
6. What is the function of the liver?
7. Why is salt mixed with ice in an ice-cream freezer?
8. Is our hair alive?
9. How was the age of the earth determined?
10. What gas was discovered in the sun before it was found on earth?
11. Why does chloroform produce unconsciousness?
12. Why do solids melt when they get more than so hot?

A Light Cultivator for the Small Garden

FIVE star-pointed disks of the easily operated hand implement for the garden, shown below, are designed to break up cloddy soil. A transverse blade just behind them, slightly below the surface of the soil, pulverizes and levels the soil they break, and cuts off weeds.

The narrow strip of soil worked by the tool—7½ inches—allows use of the tool where the rows or plants are very close together. It is said to be particularly useful after a rain, when the top soil is crusty, and in preparing a seed bed.

A woman operates the cultivator easily

Because of its ease of operation, the new tool is said to be especially useful for women gardeners.

Invisible Mirrors Reveal Secrets of Nature

ALL about us, everywhere, are countless numbers of hidden mirrors; some are invisible to the unaided eye; others are larger than our earth, and still others are so small as to be ordinarily invisible through high-power microscopes.

All these mirrors become visible by reflected light. In an evenly illuminated room, one sees nothing in the air; but if this same room is darkened and a ray of sunlight shines across the room, a cloud of dust particles is visible in the beam of light. These dust particles act as miniature mirrors and reflect light.

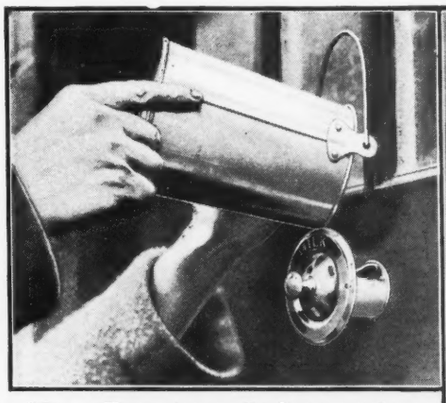
The moon and the planets are visible to us only when they reflect light shining on them from our sun. Scientists use this principle in examination of the most minute particles and microorganisms, which ordinarily are invisible through the microscope. Objects are placed on a black background and illuminated from the side. Submicroscopic particles are then seen brilliantly lighted against the dark surface, because they reflect the side rays of light to the eye.

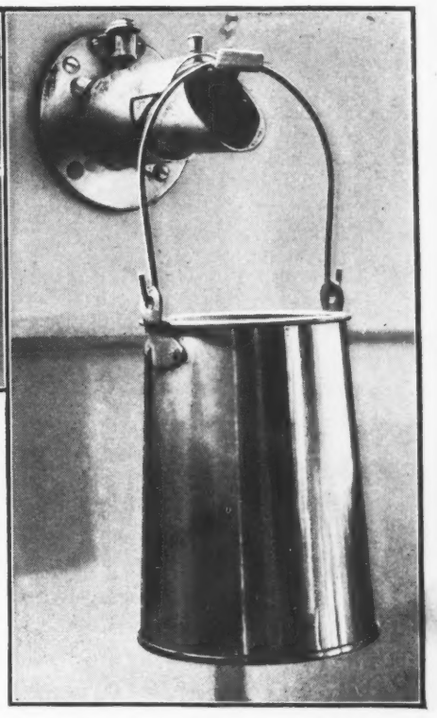
Walking Radio Receiver Entertains at Fair

A PERAMBULATING radio receiving set entertained the visitors at a recent fair in Leipzig, Germany. The complete set, including an aerial and a loudspeaker, was carried about attached to the shoulders and chest of a man.

The loop aerial and loudspeaker were mounted on a frame slung from shoulder straps like a knapsack, while the receiving instrument was hung from straps about the operator's neck.

Entertaining street crowds with radio





New Receiver Safeguards the Morning Milk

PROTECTION of the morning milk from doorstep hazards such as thieves, freezing weather, and roving dogs, is the aim of the ingenious English invention pictured here.

The milkman pulls a knob on the outside of the kitchen door or wall, exposing an opening at the end of a tube leading inside. Into this opening he pours the milk, which runs into an indoor container.

Automatic Secretary Records Phone Calls

YOUR telephone instrument can be transformed into a mechanical secretary, it is claimed, by a new instrument designed to record calls arriving in your absence, or to transmit automatically a message dictated for some one you expect to call while you are away. This is accomplished by a novel use of talking-machine records.

As many as 12 telephone calls can be recorded, the inventor asserts, but only one message can be left for transmission.

For either use, the telephone receiver is removed from the hook and placed over a contact opening in the box housing the mechanism. A clip keeps the receiver arm down. The mechanism is connected with the bell sounder, which, by ringing, releases the hook.

Two buttons, one controlling the receiving record and one to be pressed before dictating the message to be transmitted, are on top of the box. By pressing the former button, the receiver having been returned to the receiver arm of the telephone, the listener can hear one of the messages received, the particular one depending on which is indicated by the pointer of a dial at the end of the box. Another dial, below this one, is a memorandum of the unused records.

Above: Dictating a message to be transmitted by the automatic recording secretary to another party. At the right, the apparatus is shown in adjustment to receive and record incoming calls. Ringing of the phone bell automatically releases the receiver hook

Recent Publications

A résumé of new books on science and invention

How to Build Your Radio Receiver, edited by Kendall Banning and L. M. Cockaday. A comprehensive, non-technical book, giving detailed, specific instructions regarding the construction of seven types of radio receivers, ranging from a simple crystal set to the regenerative superheterodyne. Illustrated. Popular Radio, Inc.

The Problems of the Obelisks, by R. Engelbach, chief inspector of antiquities, Upper Egypt. An interesting popular exposition of engineering feats accomplished by the ancient Egyptians. Illustrated. George H. Doran Company.

The American Home Diet, by E. V. McCollum and Nina Simmonds, of Johns Hopkins University. Eighth edition. What to eat and why, including a scientific menu for every day in the year. Frederick C. Mathews Company.

Hearing, by Robert Morris Ogden, professor of education, Cornell University. A discussion of acoustics from the physiological and psychological standpoint. Illustrated. Harcourt, Brace Company.

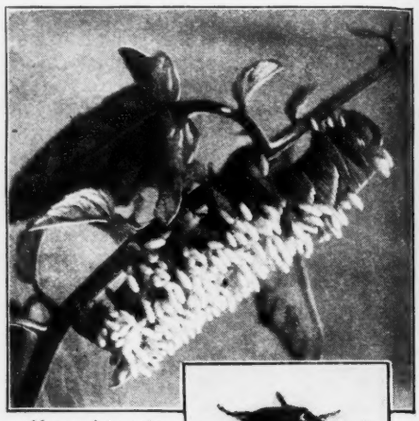
Wood-Carving, by J. C. S. Brough. A practical handbook of "The Woodworker Series." J. B. Lippincott Company.

Your GARDEN

A Fascinating Game which You Can

Persistent cultivating and weeding are the first requisites for a successful garden. The handy tool shown above does both. It can be adjusted to a four- to 10-inch spread

The common potato bug



Above: A tomato caterpillar coated with cocoons of parasitic wasps that, hatched, kill other caterpillars

Destructive flea beetle

By Ernest Bade, Ph.D.

AS WITH most other activities, so with gardening—a good beginning is most important. In the March issue of POPULAR SCIENCE MONTHLY I told how to plan and plant your garden. Yet, so far as your garden is concerned, well begun is *not* half done.

A garden requires regular, systematic, intelligent care from planting time to the harvest. Many elements—even Nature itself—conspire to place obstacles before the home gardener, and try to prevent his success. And so, once the tiny shoots have begun to show themselves above the ground, bringing your growing plants to maturity becomes a game—as fascinating and engrossing as any you have tried—in which you play a lone hand against a combination of alert and unscrupulous opponents, with your plants as the stakes.

The first adversaries you are likely to encounter are weeds. Weeds are mysterious, stealthy, greedy intruders. Where they come from no one knows. But we do know that virtually all weeds thrive only in cultivated ground under the protection of the plants you are trying to grow. Their hungry roots steal from the soil the nourishment your plants require. Some live on the very tissues of the cultivated plants. Others bring with them injurious insect pests and fungous diseases. All of them take away light, air, heat, and moisture from the soil. And, unless they are removed as unceremoniously as they have come, they will ruin your garden.

The simplest, safest, and surest way of removing weeds is to pull them up by the roots. You may, though, use a hoe, or a cultivator, or weeder. If you use tools, be sure to dig under the roots, for you will have trouble enough getting rid of the weeds that will follow those you remove, without leaving roots in the ground to sprout anew.

Don't defer weeding until your garden is choked. A little neglect in this regard may offset all the care you have taken with your garden previously.

IN ONE respect, Nature made a wise provision in causing weeds to spring up in cultivated lands. The necessity for removing weeds causes many a gardener to give to his beds attention they would not receive otherwise, and helps him in contending with another persistent enemy—surface crust.

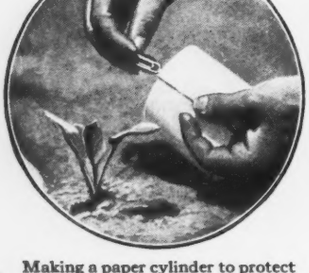
After every rain and every watering, a hard crust forms on the surface of the ground. It makes future waterings all but useless, since the water merely runs off the surface without penetrating. It also prevents air from getting to the roots.

Now, although weeding will break up this crust to some extent, I shouldn't advise you to depend on weeding entirely. Hoe your garden thoroughly at least once every two weeks. If you loosen the soil, it will retain moisture longer, and the yield of your garden will be that much greater.

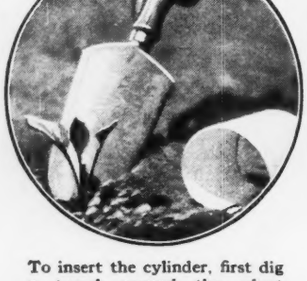
The watering of your garden is one of the most important features of its cultivation, since it is through water that the plants absorb nourishment from the soil. Give your garden just enough water—neither too much nor too little. Certainly you never should defer watering until the plants have begun to wilt. Neither should you keep the soil in your garden wet all the time. Too much water will weaken plants; too little will cause them to die. Cold water applied to a warm soil will stop the growth of plants. For this reason you never should water your garden while the sun is shining on it. Do it before sunrise or after sunset.

About the time that the weeds begin to thwart your gardening operations, another army of dangerous opponents is likely to appear—insect pests. One of the most common of these is the flea beetle, a tiny, black insect, no larger than a pinhead. It acquires its name from thickened hind legs, which enable it to hop like a flea.

This insect often destroys cabbages and cucumber vines. It thrives in dry, sunny soil, but is killed by moisture and damp-



Making a paper cylinder to protect the young plant from cutworms



To insert the cylinder, first dig a trench around the plant

Next, set the cylinder in the trench and replace the soil

To transplant, first dig a hole for the plant with a trowel

in the SUMMER

Play in Your Own Back Yard

A swallow - tail caterpillar with eggs of trachina fly near head. The larvae destroy their host

The cutworm pest

Root-destroying cabbage fly

In combatting insect enemies such as the tiny leaf hoppers, leaf lice, and bugs, which suck the sap from growing plants, the most effective weapon is the spray, applied as above

ness. If the flea beetle visits your garden, you can get rid of it by watering the plants. Dusting the beds with ashes, flowers of sulphur, or tobacco dust are other ways of controlling its inroads.

Leaf-eating insects—caterpillars and beetles of various sorts, of which the potato bug is the most common—can be destroyed by spraying the plants with a solution of three parts of crystallized arsenate of soda and seven parts of crystallized acetate of lead in water; between from one to five ounces of the chemical solution to two gallons of water.

Then there are insects that attack the roots of the plants. The common cutworm, which severs the plant from its roots just above the soil, is typical of this group. The best way to prevent these from attacking seedlings is by inclosing the plants in paper cylinders, six inches tall and about three inches in diameter, sunk in the ground to a depth of four inches, as shown in the illustrations at the bottom of these pages. Cutworms appear only at night. They can be killed by wetting the ground thoroughly with warm water (about 100° F.).

Insect enemies of another group destroy plants by introducing their beaks or probosces into the plant tissues and sucking out the sap. Leaf lice, scale insects, and the tiny leaf hoppers and bugs belong to this class. A spray with oil for a basis supplies the best method of contending with these pests, for the oil spreads over their bodies, closing their breathing pores, which are on the side of the abdomen, and suffocating them.

There is an admirable spray for this purpose that gardeners call "soap emulsion." It is prepared by dissolving two ounces of soap in boiling water, adding a quart of kerosene, and shaking. This stock solution is diluted with from nine to 20 parts of water, depending on whether the insects to be attacked are scaly or soft-bodied. When spraying, wet the leaves and twigs, but not so thoroughly that they drip. Do not permit the solution to collect in puddles on the ground, for it is harmful to the plants if absorbed by them through the soil.

Plant diseases are of many sorts, and are persistent enemies of the home gardener and the professional farmer alike. Diagnosis of the disease is essential before it can be cured. I should advise the amateur gardener not to attempt to treat his infected plants until he has consulted an expert; otherwise you may do more harm than good.

TO GET the largest possible yield from a small garden, as I explained in my previous article, beds from which early vegetables are gathered should be dug up immediately and planted with late vegetables. Winter cabbage, lettuce, or endives can be sown profitably in the beds from which the early vegetables are harvested. Better, they can be transplanted to the beds after being sown in seed beds.

Transplanting is done best at twilight. After the plants are placed in the ground, they should be well watered, and on the following day they should be kept shaded from the rays of the sun. Placing a small fruit basket over the plant is the best way of accomplishing this.

ONE final warning: gardening is a fascinating amusement, but growing a successful garden entails a certain amount of work. Don't let your enthusiasm lag. This is likely to happen when the weeds begin to show. Success in gardening is well worth working for. The physical work in the open air is bound to do you good, and there is a thrill and satisfaction in harvesting good vegetables, grown by your own care and patience, that will more than repay you for all the trouble and work you devote to them during your spare hours.

EVERY reader of POPULAR SCIENCE MONTHLY who enjoys making things with simple tools will be interested in a page of remarkable pictures of ingenious homemade oddities, to appear in next month's issue.

The next step is to place the plant in the prepared hole

With the soil replaced, make a slight depression around plant

Now pour water into the depression to moisten the roots

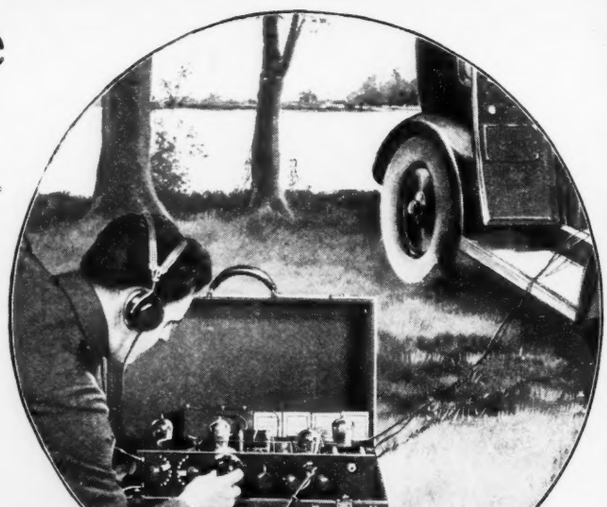
Finally, cover the transplant with a basket to shade it

An Ideal Portable Radio Receiver

—*And How to Build It Yourself*

By Joseph Calcaterra

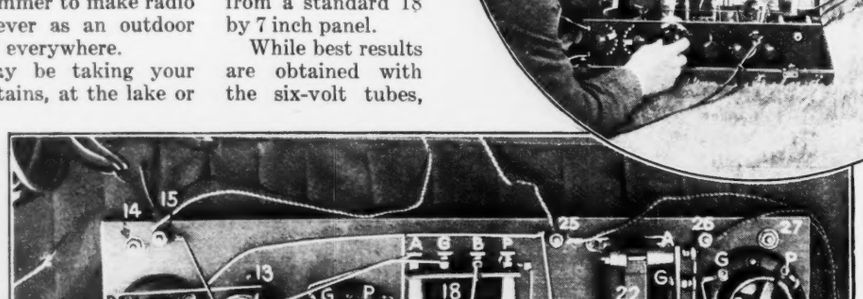
Radio Editor of POPULAR SCIENCE MONTHLY



INCREASED power of radio broadcasting stations, the perfection of more sensitive receiving sets and the reduction of interference between stations are combining this summer to make radio more popular than ever as an outdoor sport for vacationists everywhere.

Wherever you may be taking your outing—in the mountains, at the lake or seashore—radio as developed today is able to bring to you from afar the daily programs of news and entertainment. Even in a simple single-tube receiver, as Jack Binns points out in another article in this issue, there is a good store of vacation fun, even though it cannot bring you the best that broadcast radio offers.

For the man who is eager for the best possible reception during his summer outing, I shall describe this month how to construct what I believe is an ideal portable set—a powerful four-tube reflex receiver carried in a light suitcase, yet practically equal in results to a six-tube set.



Layout of parts for the portable four-tube reflex receiver. The parts are lettered and numbered to correspond with the wiring diagram below. The upper illustration shows how this compact but sensitive receiver can be carried and operated in a suitcase on the auto trip

THE circuit calls for one stage of transformer-coupled radio-frequency amplification; a reflex stage equal to another stage of radio-frequency amplification; one stage of audio amplification, with a crystal detector for detection; two stages of straight audio-frequency amplification equivalent to two stages of radio-frequency amplification, and, finally, three stages of audio-frequency amplification.

The novel feature of this circuit lies in the fact that, if desired, the circuit can be changed easily to one having one stage of transformer-coupled radio-frequency amplification, a vacuum-tube detector, and two stages of straight audio-frequency amplification. The complete set, including phones, B battery and space for tubes, can be built into a suitcase 22 inches long, 12 inches wide, and 6½ inches deep. The total weight of the outfit, without the A battery, is 20 pounds.

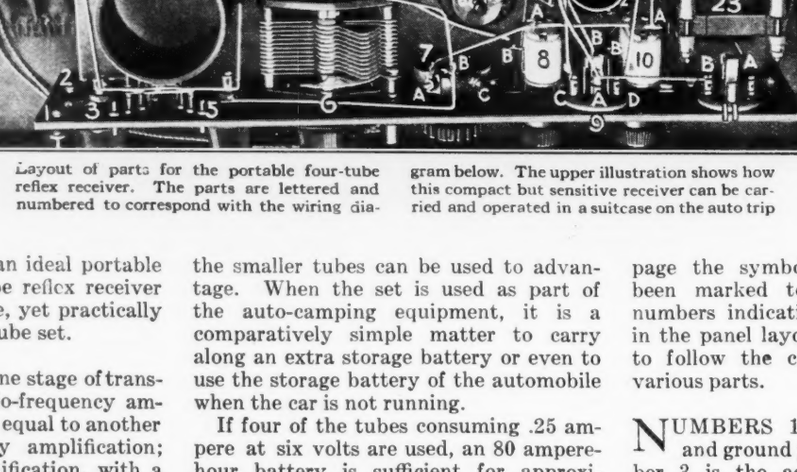
The panel is 18 by 4 inches and was cut from a standard 18 by 7 inch panel.

While best results are obtained with the six-volt tubes, the smaller tubes can be used to advantage. When the set is used as part of the auto-camping equipment, it is a comparatively simple matter to carry along an extra storage battery or even to use the storage battery of the automobile when the car is not running.

If four of the tubes consuming .25 ampere at six volts are used, an 80 ampere-hour battery is sufficient for approximately 80 hours without recharging. This will carry you through a two weeks' vacation.

Using the set shown on this page, with a two-foot loop, I brought in local stations with practically the same volume as was obtained with a standard three-tube outfit using a good outside aerial. With an outside aerial, and operating all four tubes, I received programs too loud for comfort in a large room. The first two tubes alone with the loud-speaker plugged in on the first jack were sufficient to fill the room.

In the wiring diagram at the bottom of the page the symbols and terminals have been marked to correspond with the numbers indicating the respective parts in the panel layout. This makes it easy to follow the connections between the various parts.



Wiring diagram of the portable set, with parts lettered and numbered to correspond with layout above

NUMBERS 1 and 2 are the aerial and ground posts respectively. Number 3 is the aerial inductance switch, while No. 5 is the ground or grid circuit switch.

Number 4 is the tuning coil, consisting of 60 turns of No. 22 d.s.c. wire wound on a tube three inches in diameter and three inches long. The top of the winding is started one quarter inch from the top of the tube. Taps are taken at every 10 turns. The taps are arranged in a straight line down the coil so that they will be close to the switch points of both switches.

Number 6 is a 23-plate variable condenser with Vernier feature. Number 7 is a standard potentiometer having a resistance ele-

(*Continued on page 131*)

Radio by the Roadside

How to Get the Most Vacation Pleasure from Your Receiver

By Jack Binns
America's Most Popular Writer on Radio

CAN I take my radio set with me on my vacation, or on my auto-camping trip? This question is in the minds of many radio fans now that the annual outing season is upon us.

The difficulty in deciding it lies in the widespread belief that a specially designed type of super-sensitive receiver must be used for this purpose, particularly on an automobile. As a matter of fact, any good radio receiver can bring endless enjoyment on a motor trip, provided you are careful to meet its requirements.

Of course you cannot expect loud-speaking results on the same scale as when the receiver is operated in the home, any more than you can expect the same speed out of your automobile on a bad country road that you get on a smooth-surfaced thoroughfare.

If you frankly recognize the limitations of your receiver, there is no reason why a radio vacation should not be a huge success. Indeed, it is the proved success of radio along the road, by the roadside, in the secluded camp, and by the seashore, that is opening possibilities of future communication so tremendous as to tax our imaginations. For the use and enjoyment of travelers everywhere—and especially for motorist and camper—there already have been developed radio receiving outfits so powerful and selective that they can catch messages at night from across a continent, yet so compact that you can carry them in a small suitcase.

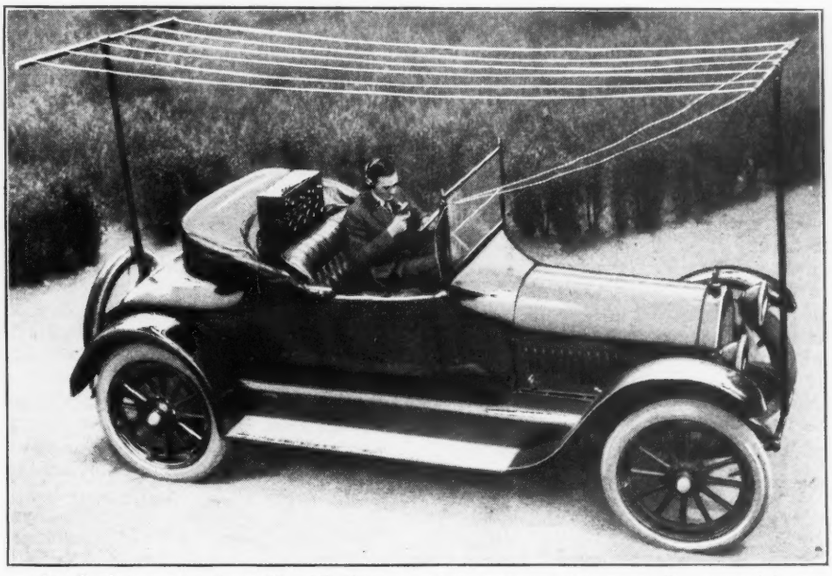
The superheterodyne is one of these latest marvels. The portable four-tube reflex set, described by Joseph Calcaterra on the preceding page, is another—just a handbag that you can carry from room to room, or in your car from city to forest and stream, from town to town, or from state to state.

With the ever-increasing demand for this sort of radio enjoyment—radio on the road—how long will it be before you will be able to carry radio about in your pocket—radio in a little box about the size of a matchbox? Simply turn a little switch, and get in instant touch with the best thought, the best music and entertainment from far-off Australia or South Africa!

Hiram P. Maxim, president of the American Radio Relay League, recently predicted that within five years all moving vehicles will be equipped with radio.

With the equipment already available there is fun and profit enough for all of us who hit the motor trail to far-off places this summer. The only problem is how to make use of that equipment. And that brings us back to practical suggestions for a successful radio vacation. And the main points to be considered are these:

"What facilities shall I have for erecting an aerial, and, how far shall I be away from the nearest first class broadcasting stations?"



An effective way to enjoy radio while the car is traveling along the road. With a multiple aerial strung between supports attached to the front and rear of the car, this outfit includes a transmitting as well as a receiving apparatus. Note the cabinet back of the driver. It is the work of an amateur, J. M. Griebe of Richmond Hill, L. I.

NOW, if your trip is to be an automobile outing, a tour from place to place, either according to a well laid out plan, or haphazardly, as the whim may seize you, it is inevitable that you will encounter widely varying conditions, so that the same arrangements for reception will not answer the purpose throughout the trip.

Consider the first of our two problems—the aerial. No matter where an automobile trip may take you, nearly always you will find some object that will stand you in friendly stead as a mast upon which to hitch your aerial. It may be a tree, a pole, or even a rock perched on the top of a small hillock. Your own ingenuity will enable you to size up the local situation quickly. The top of the auto can be used for anchoring the other end of the aerial.

Twenty years of practical experience have demonstrated that the use of a good clear aerial results in the best reception, so my advice to you is to take advantage of every local opportunity to erect one—irrespective of the sensitivity of the set that you intend to use. This improvised aerial can consist of a single wire stretched in as straight a line as possible between its two temporary supports. A long, single strand usually is better than a number of short ones. The wire should be led straight to the receiver, and should not have any excess length lying around in a coil.

Copper wire always should be used for the aerial. Of course, a stranded wire may be employed, but it should consist of copper. The gage does not have to be as large as normally used, although it should be fairly strong.

The temporary aerial can be carried conveniently on the trip simply by winding it on a fishing reel, or inside the cover of a large pocket tape-measure. If such a device is used for storing the aerial when not in use, not more than 150 feet of wire can be used. The best plan will be to run the automobile a sufficient distance away from the temporary support, so that all of the slack is taken up.

On the care with which you erect this aerial depends the entire success of radio reception in camp. When you have arrived at the spot where you wish to set up your receiver, the first thing to consider is the geographical location. Find out the direction of the nearest broadcasting station you wish to listen to. Then erect your aerial so that it points directly toward that station—that is, the free end of the aerial should be farther away from the station, and your set nearer to it. You then will be taking advantage of a peculiar directional effect that has been definitely established as existing in radio transmission.

All these suggestions, of course, apply to the reception of programs when a halt has been made. Some motorists undoubtedly will wish to attempt reception while the automobile actually is running along the road. This, of course, is entirely possible, provided the distance from a broadcasting station is not too great, and a really supersensitive set is used.

HERE again a good aerial is preferable to a loop, provided the design and construction of the set permits the use of either. Naturally, the aerial that can be erected on top of an automobile cannot be as long or as efficient as one of a semi-permanent type between two widely separated supports. Yet a very effective one can be set up by stringing a continuous wire in zigzag fashion between supports erected on the front and rear

Radio on the fishing trip—A complete receiving outfit installed on the banks of the Green River, near Seattle, Wash.

ends of the car. The metal framework of the automobile can be used as a counterpoise ground.

One serious drawback to operating a radio receiving set on an automobile while it is running lies in the fact that considerable interference will be experienced from the radiations emitted by the spark plugs of the motor, and in some cases a hum from the generator of the car. If the broadcasting station is not too far away, this interference will not be noticed, but on weak signals it will be annoying.

CONSIDER now the second of the two points that govern the success or failure of the radio vacation—the question of distance. As I said before, if you frankly admit the limitations of your receiving set, you will save a lot of embarrassment and worry during the trip. Roughly speaking, we may take the daylight range of the various types of receiver as our guide in this matter, remembering that the average reliable range of Class B broadcasting stations is only 150 miles.

The most sensitive receiver known is the superheterodyne. In the daytime it will record the average broadcasting stations on headphones at a distance of 250 miles, and with the most powerful broadcasting stations it will reproduce on a loudspeaker at 150 miles.

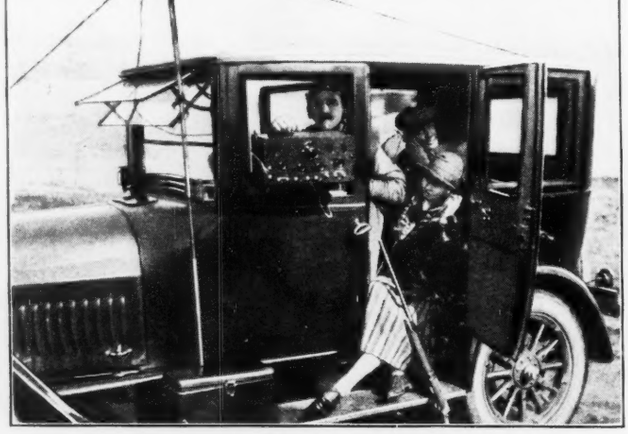
The neutrodyne will give similar results over almost the same distances. Transformer-coupled radio-frequency sets including reflex receivers, invariably operate on a loop, and their average daylight distances will be about 150 miles for phones and 100 or slightly less for loudspeaker work. Regenerative receivers of efficient construction and design will give daylight results in the same manner over approximate distances of 150 and 190 miles, provided a good aerial and ground are used.

These figures do not apply to night reception. Here an entirely different condition exists and one of which we know very little.

At night almost anything is likely to happen, and loudspeaker operation is possible from stations tremendous distances away. The possibility of hearing distant stations is entirely one of chance, however, and the radio vacation should not be planned on chance by any means.

The precautions usually observed when a set is being installed in the home for permanent use are equally important on the vacation trip.

We all know, for example, that it is very difficult indeed to receive programs inside a steel constructed building. The reason is that the steel girders, being grounded, act as a shield, absorbing the electromagnetic waves. In the city we meet this problem by employing a set that is extremely sensitive and very selective, such as the superheterodyne and the neutrodyne of good design and construction.



A radio-equipped sedan, with the aerial strung from front to rear and supported at the center by a pole

SIMILARLY, on a vacation trip, we must watch for conditions that may hamper clear reception. Remembering the difficulties of receiving inside a steel building, it would be folly to choose an outdoor location for reception where natural obstacles would duplicate the difficulties of such a building. For example, if you are in the mountains, it never will do to erect the aerial in a location where a huge mountain range intervenes between the broadcasting station and the receiving set. The mountains will act as a barrier.

An ideal location for reception is beside a body of water. This strange fact to a certain extent accounts for the location of many of the high-powered wireless telegraph stations along our seacoasts.

In some mountainous districts it is practically impossible to get away from a range of high land. The thing to do in such a case is to get as far away as possible from the hills, for the following reason:

Electromagnetic waves act somewhat similarly to water waves. The main difference is that the former pervade the medium in which they travel, whereas water waves are surface waves. You often have observed the effect of an obstruction on water waves. Immediately behind the obstruction is a "pocket" of calm water and at the rear of this pocket the waves converge.

THE same effect obtains with electromagnetic waves. A mountain range will absorb them and leave a "pocket" just behind the barrier. But at a certain distance behind the mountains, it will be possible to obtain good reception, because the waves that have not been absorbed will come together in the same manner that water waves do.

Finally, what type of receiver is best for use on a motor trip?

A satisfactory radio vacation is quite possible with a single-tube set of the regenerative or reflex type, provided a good aerial is used and head-phone reception only is desired. Much better results will be obtained with two stages of audio amplification.

The best possible results will be obtained with a neutrodyne, a superheterodyne, or a powerful reflex receiver.

BEGINNING next month, POPULAR SCIENCE MONTHLY will publish in each issue a pictorial summary of up-to-the-minute developments in radio. Here's an easy way for you to keep in step with the amazing progress of this fascinating new science.

America's Fastest Growing Sport

Motor Campers by the Million Enjoy Comforts along the Road

By Leslie V. Spencer, M.E.

"WHEN going motor-camping," said an automobile writer in an article published 15 years ago, "take along plenty of extra tubes. It is not necessary, however, to load the car down with more than two extra casings, because one is never more than two or three days from a town where the ordinary sizes of tires can be obtained."

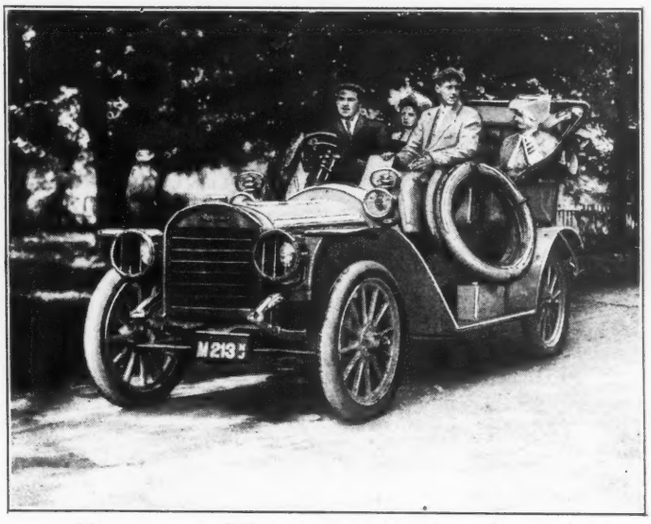
Imagine that! "Never more than two or three days from a town where the ordinary sizes of tires can be obtained." Yet, less than a score of years back, it was all too true. Motor-touring was not without its uncertainties then, and before 1910 it was practically never attempted, because of the hazards involved.

In those days an automobile hardly could be expected to stand up under the strain of from 300 to 500 miles of country going. The condition of the roads made protracted trips hazardous.

Indeed, whenever a group of hardy souls did venture forth to conquer the wagon roads of the day, they did so only after they had prepared for the journey for weeks in advance. And, when finally under way, their car looked like a small moving-van, with spades, block and tackles, cans, ropes, tents and tent poles, trunks and junk draped all over the car. The unlucky riders in the back seat had to fit themselves in with a heterogeneous collection of everything and anything that had even the remotest relation to the long-heralded camping jaunt in hand.

The popular summer sport of motor-camping as it is known today is a development of the last half a dozen years. It has been called the fastest growing sport in the world. This summer the Easterner can trek from New York to the Golden Gate, and the Westerner from California to Boston, within a reasonably short time and think little of the feat. Well-built roads, plainly marked, are taken for granted, as are public camping-grounds along many of the more important highways.

In fact, the motor-camping trip in summer has become the emancipator of thousands of American families of modest means—the outdoor sport of the multitudes. A year ago 1,250,000 men, women, and children took an active part in it; and this summer it is estimated that the number of happy motor gypsies will be increased to nearly 2,000,000.



The motor tour of 15 years ago—a hazardous adventure in a car crowded and draped with unwieldy luggage and tires

The beauty of the sport—and a feature that probably accounts largely for its increasing popularity—lies in the fact that the family with a $300 or $400 car can travel just as far and have just as much fun as the family with the most expensive limousine.

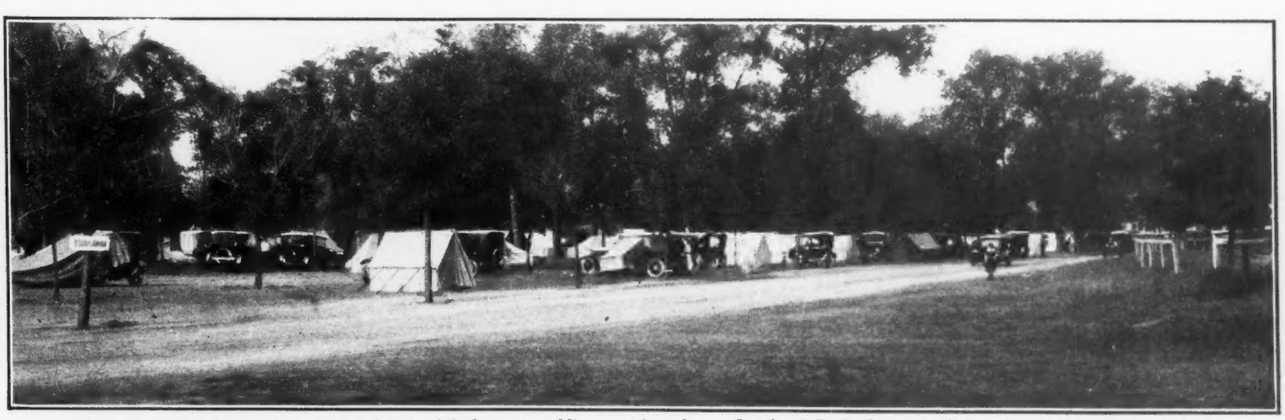
THE awakening of automobile makers to the possibilities of this new every-man's sport is evidenced by the fact that several builders of low-priced cars have been offering complete vehicles adaptable to the use of motor gypsies. A few local dealers, too, are offering specially built bodies suitable for camping. I confidently believe that within a few years we are going to see many car manufacturers add camp-car bodies to their standard lines.

Automobile camping is confined to no particular locality or climate. More than 2000 cities and towns in the United States have established public camping-grounds for the accommodation of tourists. The average size of the municipal camp-site is such as to afford ample room for about 50 cars, although some are very much larger than this.

Most public camping-grounds supply the campers with free firewood, electric light, water and laundry facilities, bath arrangements, toilets and refuse disposal. Some of the more completely equipped camps even have gasoline-and oil-supply stations, dining-rooms and kitchens, dormitories, dance pavilions, playgrounds, outdoor tables and benches, wooden tent floors and other enticing features.

OVERLAND PARK, at Denver, Colo., the largest public camping-place in the United States, is a striking example of what some of our larger cities are doing to encourage motor tourists. With very complete facilities, this camp affords accommodation for 1000 cars. The tract is beautifully wooded, and it cost the city $250,000. Last year more than 60,000 motorists availed themselves of its privileges.

Motor-campers do their summer vacationing in one of these four ways: Some pack everything into a touring-car or sedan and make and break camp at each stop. Others tow a trailer that carries all the camping paraphernalia. Still another group does a more pretentious job of it by hauling a completely equipped camping-car trailer containing beds and dining accommodations. The fourth class buys a special camping-car fitted to almost any standard chassis. This last is the de luxe way of gypsying, of course, and involves considerable expense, for as yet there is very little standardization of



Part of a mile of tourist tents in the world's largest public camping-place—Overland Park, Denver, Colo. Sixty thousand motorists camped here last year. Other cities have provided similar parks to accommodate some of the 2,000,000 motor-campers this summer

self-contained camping-cars. By far the greatest number follow the first method.

The two important essentials to this kind of wandering outdoor life are eating and sleeping, and to these necessities the makers of auto-camping equipment have devoted their thought and ingenuity.

Most of the conveniences of home are provided by this campers' folding bungalow mounted on a small trailer. It contains two full-size beds with springs and mattresses, kitchenette, icebox, water tank, supply closets, and several folding chairs and tables

GONE are the days of the pup tent. Your motor-camper now demands a specially constructed motor-camping tent or a set of beds under even a more substantial roof than canvas can offer. Motor bungalows on wheels that possess every convenience for the night's rest, are available at considerable expense, but the dyed-in-the-wool camper usually prefers canvas.

Tents are of many and varied types, ranging from the lean-to supported by the top of the motor-car to the full-grown motor bungalow tent with comfortable accommodations for four or more.

Most motor tents are arranged to collapse into very small packages, having folding metal braces and uprights, and folding into bundles small enough to be carried on runningboards.

The specifications of one tentmaker's prize package are before me. They make it clear that you are afforded a big double bed with springs and mattress rivaling in comfort your best box-spring bed. The bundle also disgorges a big, roomy, well-ventilated tent that requires no poles to erect—a real house, with screened and curtained windows. The specifications say further that the whole outfit with its aluminum-frame bed rolls into a package only four feet long and 11 inches thick.

THERE'S development for you! Think of that, and then consider the trouble it meant to carry the unwieldy tents of a few years back. Then, if you got the whole works into a full wagon bed, you were lucky.

Another clever outfit on the market is called a "sleeping pocket"—a pneumatic mattress and envelope arrangement with a flap at the top. The outer material is waterproof, and when you crawl into this cocoon and pull down the flap, you are snug as the proverbial bug in the rug. Also you are protected from insects.

Many campers sleep in their cars on some form of swinging mattress fastened at back and front above the seats. If the car is a closed type, such a bed offers all the comforts of home.

About a score of concerns now are making camping trailers. When ready for the road, the newest trailer outfit is most compact, folding into a size not much larger than a pushcart. Opened up, it provides a temporary home for from four to six persons. Many of the models have elaborate cooking and dining facilities, folding tables and chairs, full-length clothes-closets, and tanks for hot and cold water.

The days are vanishing when the motor-camper depended on wood fires. Now he usually carries a compact and convenient oil or wood burner that eliminates the digging of pits and the building of ovens. When it comes to cooking utensils, the market is full of apparatus with special appeal to the camper.

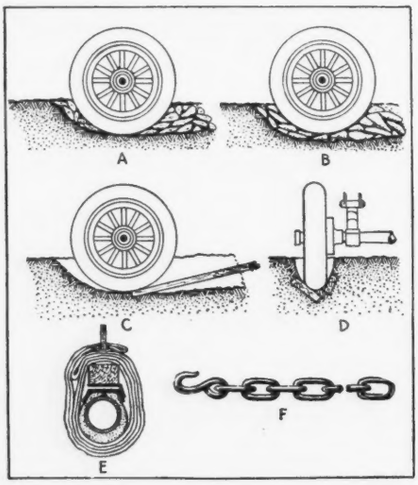
When Your Car Is Stuck in the Mud—How to Get Out

IF, ON your motor-camping trip, you plan to strike away from the beaten highways into out-of-the-way places, as most campers do, the chances are that sooner or later your car is going to be stuck in a mud hole on some lonely country road.

Will you be prepared for such an emergency? Will you know how to get out without ruining your tires, your gears, and your disposition?

If you are impatient and foolhardy, you probably will go into "low," race your motor, spin your wheels, and sink deeper and deeper in the mud until you are up to the hubs. But if you want to save trouble and expense, you will remember that it doesn't pay to lose your head. You will sit quietly and study the best way to get out.

The best way, of course, is to get some one to pull you out. But it is not always easy to find that "some one." If you have chains, don't try to put them on in the regular way, but wrap one entire chain twice around each rear tire crosswise between two spokes and fasten it with the clips as best you can. Start your motor, *go into reverse*, and you can pull out of almost any kind of a hole.



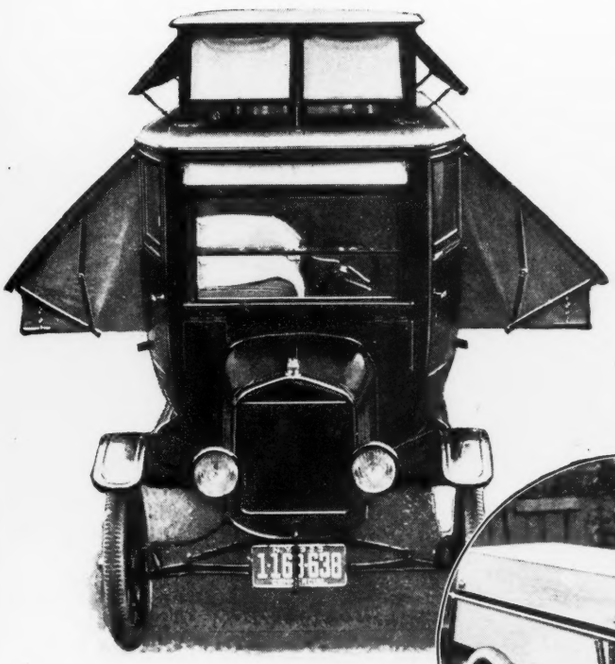
The average driver, when his car is stuck, packs around the wheel as many large stones as he can find, as shown in illustration *A*. He believes they will work under the wheel, as in illustration *B*, when the wheel is revolved, and will form a solid foundation. As a matter of fact, the stones seldom get under the wheels in sufficient number to do any good.

After "chewing up" his tires in this experiment, he removes a few rails from a near-by fence and tries to wedge them under the wheels. The result usually is unsatisfactory, producing a condition such as that shown at *C*, or at best like that at *D*.

THE best way, if you have no chains, is to use a piece of rope, an old tire cover or an oilcloth side-curtain envelope, or any other bulky material you can wind around the tires to give necessary resistance. If you have none of these, a couple of worn-out inner tubes will serve in a pinch. The ordinary tube will go twice around a tire doubled, between two spokes, as shown in *E*. By cutting a hole for the valve, you can button the tube so that is will stay there.

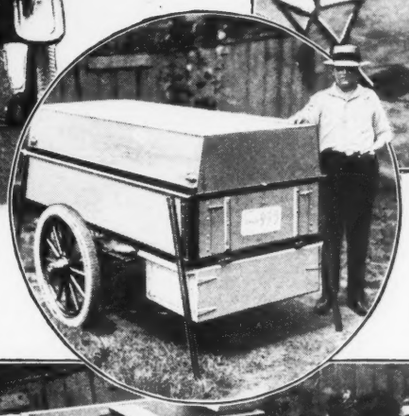
The real insurance against sticking fast in the mud, is to be prepared by always carrying with you six pieces of heavy chain, each with a hook at one end, as shown in *F*. Three of these chains hooked around the tire and felloe of each rear wheel will pull you out of the worst hole you can conceivably get into.

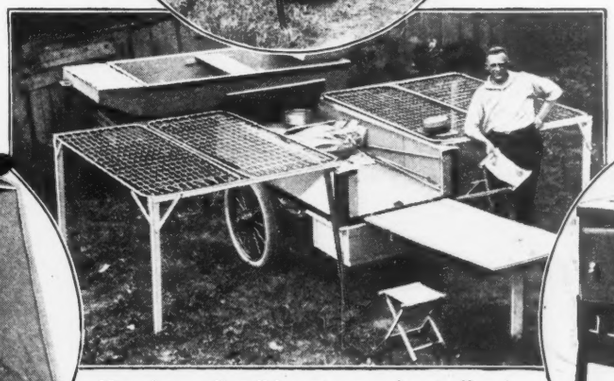
New Ideas for the Folding Camp

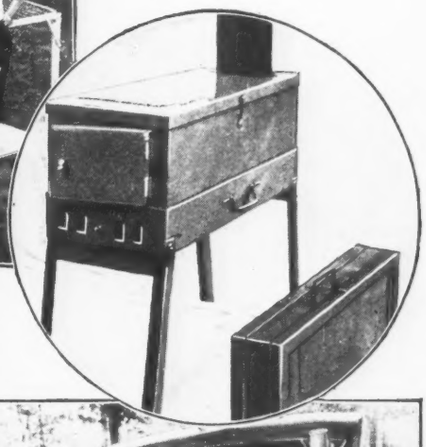


Five simple operations, requiring about 30 seconds, convert this unusual campers' sedan into a cozy, insect-proof house with adequate bedroom, kitchen, locker space and toilet conveniences. Four adjustable chairs that seat the travelers in the daytime are transformed at night into two comfortable double beds

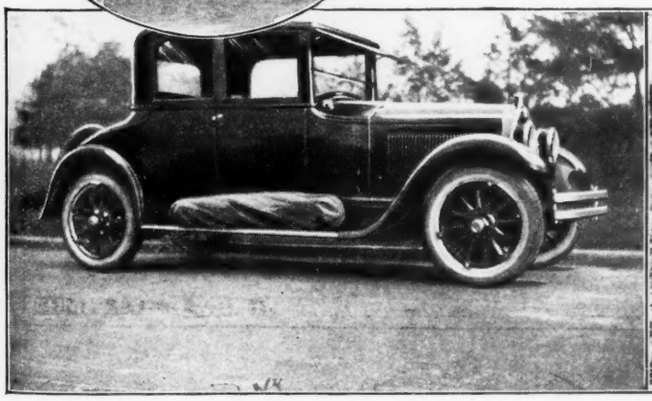
This camping outfit, contained in a detachable box body, is designed to fit runabouts with removable turtle backs. An upper compartment of the body carries luggage, food and cooking utensils, while the lower part carries the bedding. The rear panel drops down to serve as a dining-table. With the compartments removed and the top tilted upward, at an angle, the cabinet serves as a sleeping tent







Here is a collapsible auto-camping trailer de luxe. The upper picture shows it folded for travel. When unfolded, it provides two double bedsprings, fireless cooker, table, and icebox. The top forms a small duckboat



A new square tent of waterproof canvas can be carried on the runningboard. Instead of a center pole, the steel frame is held by four stay rods joined by a central lock adjusted by a central screw shaft, as shown in the upper picture

Light folding chairs, table, and camp stove which, when collapsed, occupy small space in the car, add to the comfort of the roadside camp. The novel stove shown in the upper picture folds into the small case shown at the right

Repair Kinks for Motorists

Breakdowns rarely happen when small repairs are made promptly

PROPELLER shafts are difficult to remove and replace when reassembling the car after a rear-end repair job. Most repair men do this work by hand, although it is a back- and arm-breaking proposition. A common screw-jack with ratchet handle can be made to assist greatly not only in this, but in other repairs.

The jack is bolted to a wooden base to which casters are fitted so that it may be rolled around. A special yoke, made to hold the shaft, fits in place of the usual jack top, as shown in Fig. 1. By having the yoke a loose fit on the screw top, it is free to turn in all directions.

To operate, the jack is placed beneath the shaft tube and is elevated until the yoke takes the weight of the unit. The set-screw is then tightened and the outfit is ready to be pulled out. This also keeps the splined end of the shaft out of the dirt.

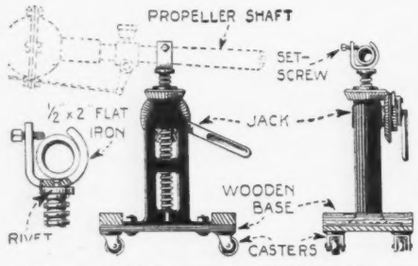


Fig. 1. Jack for propeller-shaft repairs

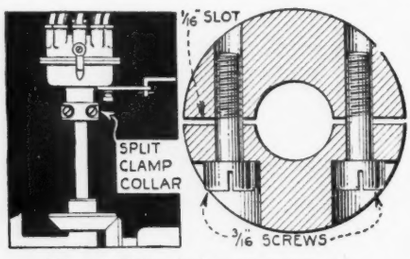


Fig. 2. Collar holds gears in mesh

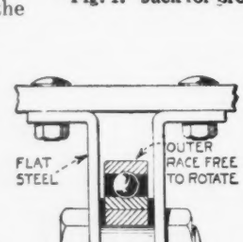


Fig. 3. Creeper wheel

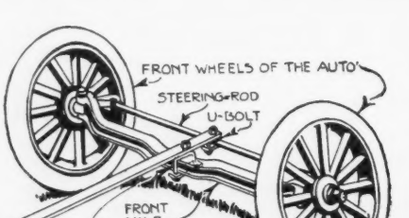


Fig. 4. Drawbar connected with steering-rod simplifies task of leading an automobile

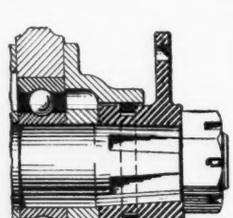


Fig. 5. Oil seal

DISTRIBUTER gears of certain cars cause considerable trouble by jumping out of mesh when the car hits a bump or depression in the road. This can be remedied by fastening a split collar to the vertical shaft just under the distributer, as shown in Fig. 2. The clamp collar is made of steel, drilled and tapped as indicated, and fitted with two small screws. In this way a permanent repair can be made without dismantling any of the motor parts.

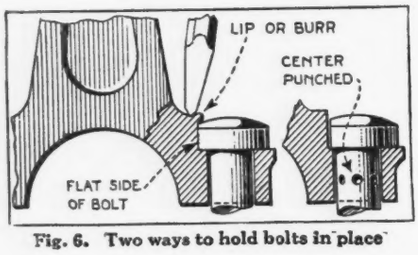


Fig. 6. Two ways to hold bolts in place

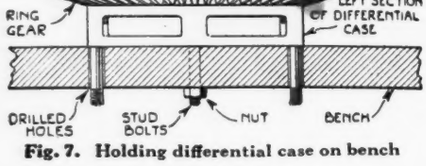


Fig. 7. Holding differential case on bench

THE ball-bearing roller for a creeper, shown in Fig. 3, was made out of discarded automobile parts and a few worn bearings. Four of these rollers were fastened to a frame made of two 1 by 4 ft. boards. A padded headrest was fastened to one end to make the creeper more comfortable. Such a rolling platform also can be utilized very well to move heavy auto parts, such as axles, around the garage.

LEADING a car is a difficult thing unless there is some one in the car to steer it. A farmer was confronted with this problem when he tried to pull the car along behind a tractor. He solved it by using a drawbar such as is shown in Fig. 4. The bar, which is 6 ft. long, is fastened to a U bolt on the front axle. A smaller U bolt clamps the end of the bar to the steering-rod. As the front end of the bar is moved, the bar swivels on the axle fastening, moves the steering-rod to one side, and in this way turns the wheels in the desired direction.

OIL leakage is a frequent trouble in truck transmission systems. One truck repairman solves this problem in an ingenious manner as shown in Fig. 5. He removes the propeller shaft at the rear end and cuts a square groove in it on a lathe. Into this groove is fitted a scrapped motorcycle piston ring, the dimensions of which suit the job exactly. The constant outward pressure of the ring seals the case most effectively.

WHEN fitting connecting-rod bearings, the bolts have an annoying tendency of falling down inside the crankcase. This can be prevented in the two ways shown in Fig. 6. One of these consists of turning a burr over the head of the bolt with a chisel or center punch. A small burr is all that is necessary. A second method is to make a ring of center-punch marks around the shank. These marks should be placed halfway through the bolt hole to allow the bolt to pivot slightly if necessary, to accommodate the cap. Bolts so remedied are driven into their holes with a light driving fit and make a neat, serviceable job.

IN BOLTING on the ring gear or reaming the bushing for the pinion, the left half of a Ford differential case can be held to the bench top by means of three studs passed through holes in the top of the bench. It would be satisfactory to hold the case in the jaws of a large vise, using special clamps to suit the curvature of the body of the case; but the method shown in Fig. 7 is far simpler and holds the work as rigidly as is necessary.

WHILE many methods have been devised to prevent unauthorized joy-riding, one recently installed by an electrician is especially novel.

It was done by making a special handle for the gear-shift lever with an insulating gap between the ball-shaped handle and the rod. A lead from the secondary terminal of the induction coil is brought to this ball handle through the center of the shift-lever. With the engine running, any effort to shift the gears causes the full intensity of the high-voltage current to pass through the driver as his foot is on the clutch pedal completing the circuit.

The current is not injurious, but is so startling that it will unnerve and weaken the most daring thief. A cut-out switch at the edge of the cowl is carefully thrown out before the owner starts to drive.

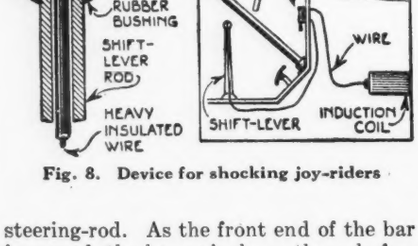
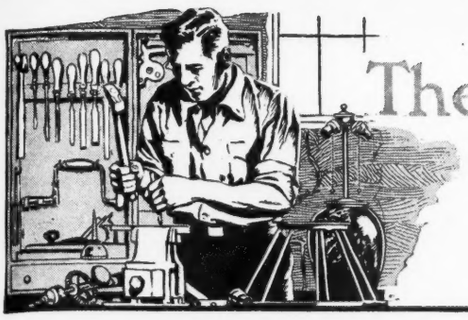


Fig. 8. Device for shocking joy-riders



The Home Workshop

Arthur Wakeling, Editor

Equipment for Auto-Camping in Comfort

By Harold N. Whitmore, M.E.

IF YOU are going auto-camping this summer and wish to have genuine comfort and convenience without undue cost, I can recommend the equipment shown in the accompanying illustrations.

Designed and built at home after a year's study of various types of camping cars, the outfit gave most satisfactory service in a summer spent outdoors last year and will be used again this year. It attracted much attention at every tourist camp I visited, principally because it incorporates many of the conveniences of more elaborate and more expensive outfits without some of their objectionable features.

Among the outstanding features are compactness, light weight, and comfortable sleeping quarters. Last, but not least, with this type of equipment, the runningboards and the inside of the car are not burdened and crowded with canvas, poles, boxes, stoves, chairs, cots, and other paraphernalia. Camp may be set up in eight or 10 minutes.

The cost of the materials necessary for building the outfit, including cooking equipment, was approximately $100, with careful buying.

The outfit is attached to a standard Ford runabout with the turtle back removed. However, it may be attached or modified to suit many other makes of roadsters and coupés.

The small illustration at the right of Fig. 1 shows the rig as it appears on the road. Everything is inclosed within the box on the back, which in turn is covered with waterproof canvas and held in place with a well known type of patented, lift socket fasteners. The spare tire is carried suspended on straps under the rear of the truck box. The entire weight is about equal to an empty Ford sedan.

In Fig. 2 the canvas cover is shown

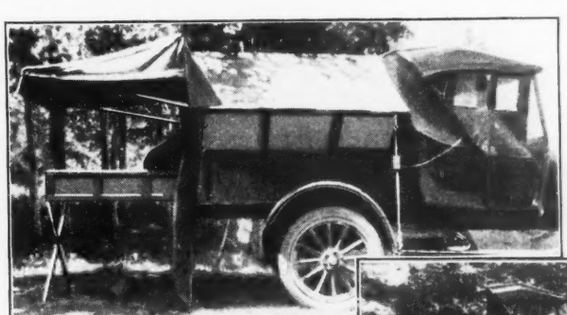


Fig. 1. How camp is made (above) and the entire equipment packed in the body for touring (at right)

removed and the top opened out to form the sides and screened windows of the sleeping compartment. The tail gate is down and the ridge pole in place. The two arms extending from the ridge pole are on hinges and fold back against the ridge pole for packing. These arms support the awning, which covers the kitchen compartment. The front end of the ridge pole is attached to the top of the car between two angle irons, through which a pin passes. The upright pole is made of wood with ¼-in. iron pins in each end. The upper pin passes through a hole in the ridge pole, while the lower pin passes through a hole in the iron frame of the bedsprings. The bedsprings are visible in this view. The drawer containing supplies, stove, and other equipment is in place under the bed.

The central illustration in Fig. 1 is a side view with canvas in place and the drawer pulled out. The canvas is attached with the curtain fasteners mentioned before. The arms extending from the ridge pole support the front of the awning, while a collapsible ¼-in. pipe is inserted in a canvas tunnel at the back. Two wooden poles in the body with metal pins in each end hold the awning in place.

In order to avoid too great an overhang, the box and consequently the bedsprings are only 5 ft. long. However, the mattress is 6 ft. long, the extra foot being supported at night by the sliding top provided on the drawer. The canvas end covering this extension, as well as the entrance to the bed, is shown in this view (Fig. 1). The drawer is supported on adjustable and detachable legs. In this illustration also appear the tent ropes, which provide means of stretching the canvas roof of the sleeping compartment.

Figure 4 shows a three-quarter rear view with the side drops attached to the awning. These drops are put on in bad weather and at night. There is one

(*Continued on page 118*)

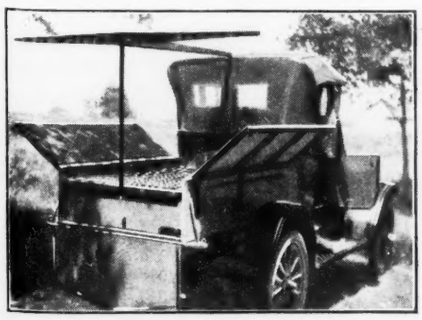


Fig. 2. Side windows, tent poles, and bedsprings with storage drawer underneath

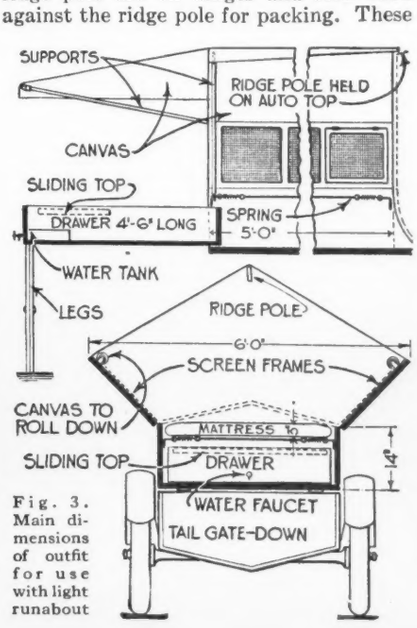


Fig. 3. Main dimensions of outfit for use with light runabout

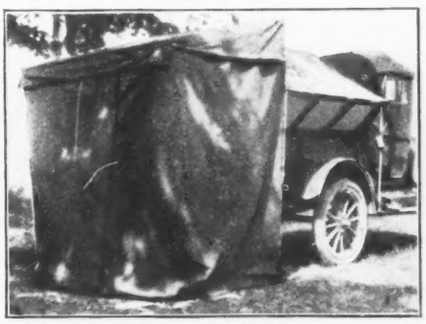


Fig. 4. Awnings and side drops in place for the night. Note screened windows

Garage Doors Built in Place to Save Labor

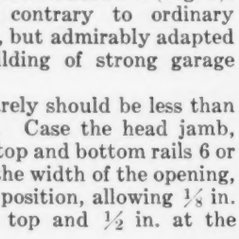
By Edwin M. Love

AMATEUR carpenters usually make hard work out of the building of garage doors; and not a few good carpenters pursue methods that are slower and more difficult than that herein described.

In all types of doors consisting of stiles and rails sheathed up the back, run the top and bottom rails the full width of the doors, and cut the stiles between (Fig. 3). This system is contrary to ordinary door construction, but admirably adapted to the rapid building of strong garage doors.

The opening rarely should be less than 7½ ft. in height. Case the head jamb, cut the 1 by 6 in. top and bottom rails 6 or 8 in. longer than the width of the opening, and nail them in position, allowing ⅛ in. clearance at the top and ½ in. at the bottom.

If a pair of doors is to be built, as the illustration shows, tack the center stiles in position. For sheathing material, 6-in. V-grooved redwood ceiling ¾ in. thick usually is used in my own locality in California. It should be cut ½ in. less than the length of the completed door and applied with a ¼-in. margin at top and bottom. Ceil from the center, as in Fig. 1, by toenailing top and bottom with fourpenny box nails. When a few boards are in place, cut in the center rails between the stiles and nail solidly to the sheathing.



Then complete nailing on the ceiling.

For a single sliding door, no braces are required. For double doors, either hinged or combination hinged and sliding, braces should be provided, running upward toward the front edges.

All the ceiling being on, nail each edge

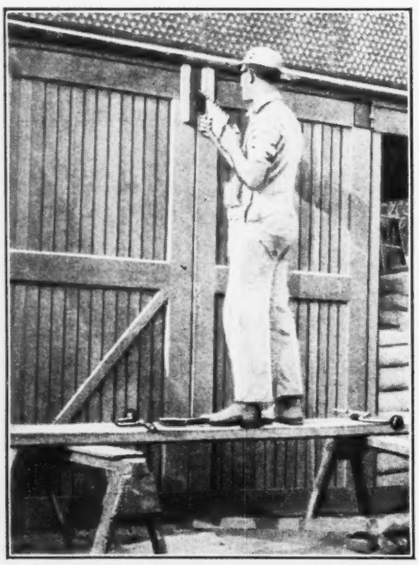


Fig. 1. Nailing on the panel material (at left). Fig. 2. Cutting the rails (above). Fig. 3. The finished doors (upper right hand)

from the front with sixpenny box nails staggered to catch both edges of the rails and stiles. Then clinch the nails at the back, either by driving the points over and into the ceiling with a nail set, or by having a helper hold an ax against the nail heads while the points are driven over.

A door built in this way is fitted and in position for hanging. Tack blocks to the upper ends of the stiles and the casing

above, as in Fig. 2, and saw through the rails. Case the side jambs and apply hinges, or hangers, and remove the blocks. Nothing remains but to dress the sawed ends of the rails and to put on the remainder of the hardware.

Doors like these are capable of standing a surprising amount of wear and tear, and are amply strong for mild climates. If subjected to storm and freezing, the following modification is recommended: After building the door to the point of nailing from the front through the stiles and rails, reenforce with rails and stiles behind the ceiling, extending the center rail the full width of the single door and the stiles to the top and bottom, as shown in Fig. 4, afterward nailing solidly from the face of the door as described above, using tenpenny box nails clinched at the back.

It is an excellent practice to coat all joints and lapping surfaces with heavy paint as the parts are put in place, as this safeguards against dampness.

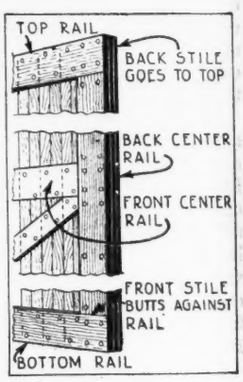
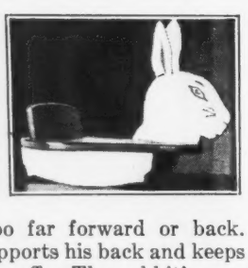


Fig. 4. Detail of doubled rails and stiles

Novel Bunny Rocker Will Amuse Any Small Child

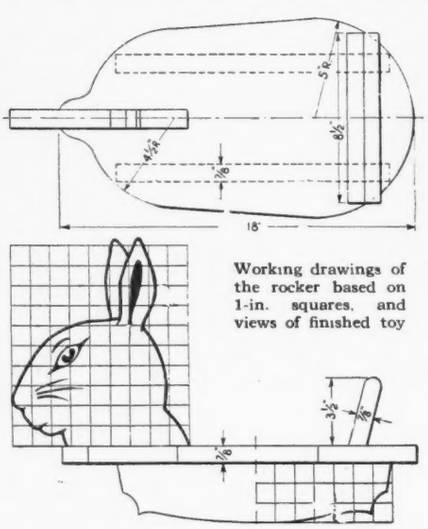


TO amuse Junior, the little rocker illustrated has many merits. The unusual design of the rocker piece prevents him from rocking too far forward or back. The back rest supports his back and keeps him from sliding off. The rabbit's ears afford a convenient hand-hold, and if the baby does manage to fall off, the seat is so close to the floor that no harm will result.

The rocker is not difficult to make and decorate and will give the youngster many hours of amusement. Use a soft wood, as it is easy to work and will look well when enameled.

For the seat you will need a piece of ⅞-in. stock, 1 ft. 6 in. long and 10 in. wide. Lay out a center line lengthwise of the board. Set compass or dividers for 5 in. and lay out a half circle at one end. Lay out the other curves, and shape by using the draw-knife and the plane to finish the curves wherever possible.

By use of the squares, each of which



Working drawings of the rocker based on 1-in. squares, and views of finished toy

represents one square inch, lay out the head of the rabbit, with the grain running vertically. A turning saw is a good tool for cutting out the head. The squares also will facilitate laying out the rocker

pieces, two of which are needed. Next, cut out the back piece. Plane the lower edge so that it will tip back slightly when fastened to the seat.

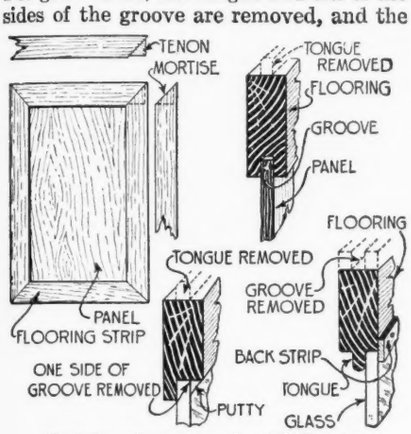
In assembling, use long screws or finishing nails. If screws are used, set the heads into the wood and fill the holes with wooden plugs. If nails are used, putty will do to fill up the holes when the heads have been set in.

Sand the job thoroughly, finishing up with 00 sandpaper. Paint the rockers and the head white, and the seat and back piece a bright red. Give two or more coats, as needed. When the last coat is thoroughly dry, take a fine brush and paint the eyes, whiskers, and mouth and outline of the ear with black enamel. Use pink, if at hand, for tinting the nose and indicating the markings on the inside of the ears.—KENNETH R. LA VOY.

Flooring for Furniture

THE home workshop enthusiast who has but few tools sometimes finds it hard to make panel and glass doors for furniture on account of the lack of grooving or combination planes. I have found that the use of grooved flooring for the frames of the panel doors and glass doors solves this problem for me. The flooring comes in so many grades and widths that almost any need may be met by using it.

For panel doors the "tongue" of the flooring is removed and the panel mounted in the grooves of the inside of the frame. For glass doors, the tongue and one of the sides of the groove are removed, and the



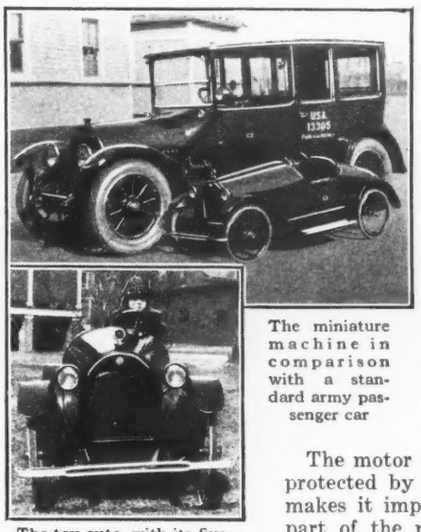
Neat door frames made with flooring

glass is mounted against the remaining side of the groove. Another method is to remove the groove side of the flooring and mount the glass against one side of the tongue, as illustrated above.

Toy Roadster Has Electric Drive

PERHAPS no toy delights children more than a miniature automobile that will run like a real car. To build such a toy is within the ability of any skilful mechanic, although it would be difficult to equal the remarkable completeness and finished workmanship of the unique little roadster illustrated.

This car was designed and built at the Motor Transportation Repair Shop of the Coast Artillery School, Fort Monroe, Va., by Technical Sergeant Theodore P. Gunther for his five-year-old daughter, Pauline. The work required about 700 hours of Sergeant Gunther's spare time, spread over five months, and he still has to add a windshield and top.



The miniature machine in comparison with a standard army passenger car

The toy auto, with its five-year-old driver at the wheel

The roadster is operated by a storage battery and electric motor, belt driven to the differential. The battery, which consists of seven cells of 120-ampere-hour capacity, is divided into three sections, two of two cells each being under the hood in front and the remaining section, of three cells, in the rear compartment. They are connected in series to give 14 volts altogether.

The motor is an old automobile generator rewound for this purpose. The current consumption for motive power only is from 9 to 12 amperes; the lights, which include headlights, dash and tail-light, require 5 amperes, and the horn, 3 amperes.

For the sake of safety and in mercy to daddy, who walks while his little daughter rides, the speed is limited to a maximum of 6 miles an hour. The controls are the same as in most passenger cars; that is, clutch and brake pedals, gearshift lever, emergency brake lever, spark and throttle levers. There are three speeds forward and one reverse.

The motor and running gear are protected by a safety device that makes it impossible to injure any part of the mechanism by faulty manipulation of the controls.

Miss Pauline has driven her car from 250 to 275 miles without a breakdown, and she handles it like a seasoned driver. She knows her simple traffic rules and the customary hand signals to those in the rear and she can talk automobile from the front bumper to the spare wheel. The novel little car has became a familiar sight in and around Fortress Monroe.

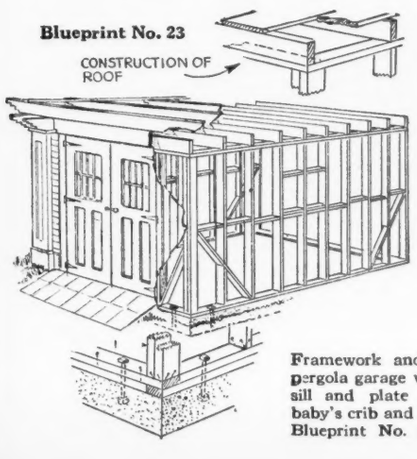
Money-Saving Plans for Your Home Workshop

THREE unusually popular spring projects for the home worker are the pergola garage, the baby's crib and play pen, and the canoe sailing outfit illustrated.

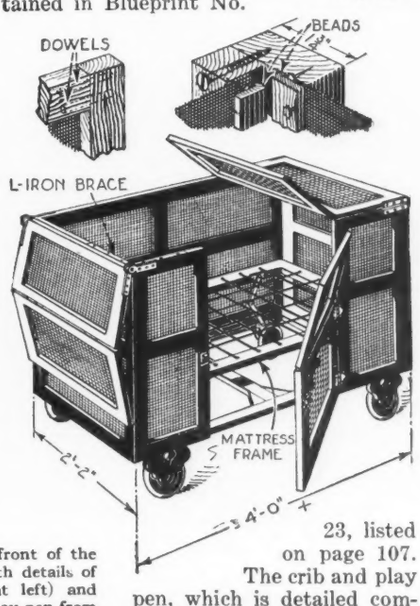
Selected from POPULAR SCIENCE MONTHLY'S long list of blueprints in response to the requests of readers, these designs are especially appropriate for construction at this time of the year. They can be built at a considerable saving over their commercial equivalents.

For the man who has bought or is going to buy his first car, the pergola garage has many advantages. Costing only from $150 to $200 for all materials, it is different from common stock designs and fits well in a garden setting. Full working details and bill of materials are contained in Blueprint No. 23, listed on page 107.

Blueprint No. 23

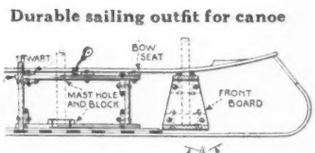


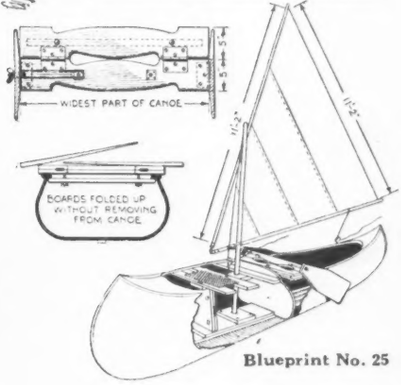
Framework and front of the pergola garage with details of sill and plate (at left) and baby's crib and play pen from Blueprint No. 26 (at right)



The crib and play pen, which is detailed completely in Blueprint No. 26, has an adjustable mattress frame which is attached to the lower frame with 14-in. rule joint stay or support hinges, so that it can be raised readily.

Durable sailing outfit for canoe





Blueprint No. 25

The sportsman and canoeist will find the sailing outfit for a paddling canoe (Blueprint No. 25) an improvement over ordinary designs.

Each blueprint can be obtained for 25 cents from POPULAR SCIENCE MONTHLY.

Simple Buffet to Complete Dining-Room Set

By E. E. Scott

FOR one reason or another a buffet has been ommitted fro the furniture of many dining-rooms, especially when there is a built-in china closet in the room. This gap in the furnishings may be closed readily and inexpensively by building a buffet in the home workshop.

The Adam style buffet illustrated, in which straight lines predominate, requires a minimum of time and skill. Mahogany or baywood, which is really a grade of mahogany, is the most suitable wood for this particular design, although oak or birch will answer nearly as well, depending upon the furniture that is to be matched.

Excellent proportions and simplicity of design distinguish this unusually attractive home-made buffet

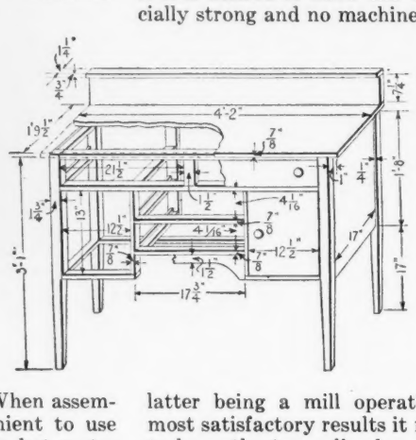
The first consideration is to select stock that is free from checks; if wood other than mahogany is used, all warped and knotty pieces should be rejected—mahogany rarely warps or checks and that which reaches this country usually contains no knots.

Twenty board feet of ⅞-in. stock are required for the top, back board, doors, and drawers; 6 ft. of ⅜-in. stock for the end panels, and 13 running ft. of 2 by 2 in. stock for the legs. The "out of sight" parts of the drawers, back, and bottom may be made of ⅜-in. whitewood, of which 35 board ft. are required. There also will be required 40 lineal ft. of ¼-in. birch or maple strips 2 in. wide for the inside framework, which also serves as runways for the drawers.

The first step is to make up the legs in pairs, mortised to receive the framing strips and the end panels. If possible, have the mortise for the end panels run out on a sawtable at the mill, as it is important the fit should be accurate. When assembling the frame, it is convenient to use flaked cabinet glue melted in hot water and applied while hot. Dowel together the parts wherever the thickness of the stock permits.

Before the top is put on, the whole interior framework should be assembled and the drawers made and fitted so they will slide easily. Put small stops at the back to prevent the drawers from being pushed in too far. If polished steel drawn slides, like thumbtacks, are used at the front of the drawer runs, they will reduce the friction considerably.

The drawers may be subdivided as desired. The top middle drawer in this case has divisions for forks, knives, and spoons and extra pieces, and a narrow, false and secret section in the rear for solid silver. If it is desired to have the drawers especially strong and no machine work is to be done on the joints, they should be made of maple or birch and held together with long, thin screws.



The top can be put together either with dowels or with splined joints, the latter being a mill operation. For the most satisfactory results it may be as well to have the top splined and glued at the mill, where it also can be run through the planer and all inequalities removed. If this is done with mahogany, the joints are nearly invisible.

The top is held on by a ¾ by 1 in. strip on all sides except the front, where the top framing strip serves this purpose. It will be noted that the top overhangs 1 in. on all sides except the back, where it is flush. The back board is not attached until the finishing is complete, the piece being made up and finished separately and held in position with screws. This is so that it can be taken off if necessary for moving.

THE wooden door and drawer knobs can be turned or purchased unfinished. Hinges, locks, catches, and casters complete the fittings.

To finish the piece, first apply a coat of dark red or, preferably, brown mahogany stain. Allow the wood to dry for 24 hours and apply another coat, wiping off all surplus stain. After another 24 hours, apply a coat of white shellac well thinned down with denatured alcohol and allow it to dry thoroughly, after which it should be finely sanded. Follow with a coat of any standard furniture varnish and sand well.

A second and third coat should be applied, each of which should be sanded smooth and rubbed with fine powdered pumice-stone. The method I use is to sprinkle the surface liberally with pumice and enough oil to form a paste when rubbed circularly with a wad of cloth.

THE Home Workshop Department's series of articles on built-in furniture of the type now so popular, will be resumed next month with an article by Edwin M. Love on corner china closets.

How to Adjust Your Auto Valve Tappets

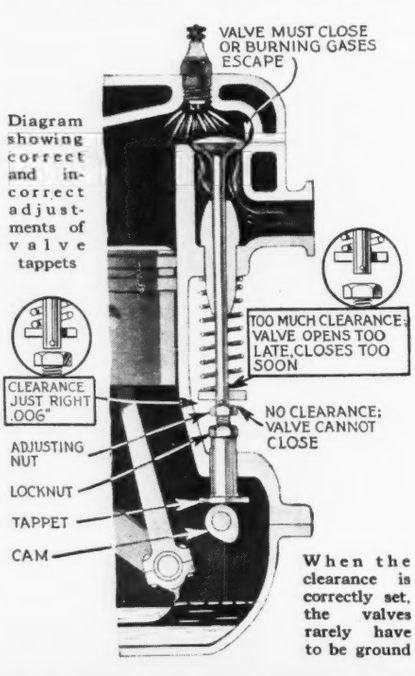
"WILL you remove the carbon from the engine for me this morning?" asked an owner friend the other day. "You know," he continued, "that is about all I ever have done to the car. I used to have the valves ground every two or three thousand miles before I learned how to set up the tappets.

"When I first got the car, I had one noisy tappet. I adjusted that so it was quiet, and then found there was another one louder than the rest. I kept on setting them closer and closer until I was losing power, and had to be grinding the valves every little while. Finally I set them all with considerable clearance, and tried to get them all just the same. The engine was not quite so quiet, but there was no annoying noise. I have driven the car 32,000 miles, and have not ground the valves since."

This owner has learned the secret of economical valve care. Valves set too close will become sooted and burned. Many very quiet engines lack power because the valves are set so close that when the engine gets hot, the valves are on the verge of holding open. This results in burned and pitted valves, and, if continued for any length of time, will result in worn and noisy valve mechanism, since the force of the explosion must be borne by the valve stem and cam.

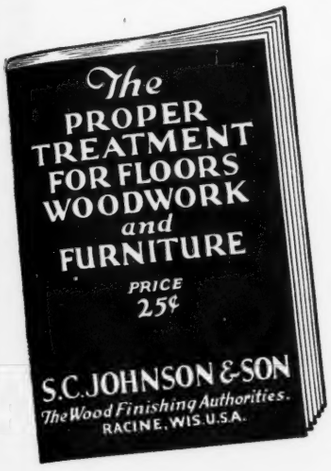
The poppet type of valve requires on an average of .006 in. clearance between the bottom of the valve stem and the lifter, if in an L or T head, and the push rods on the I or overhead type require as much.

To prevent an irregular noise, set all tappets just the same. This results in a regular sort of hum from the engine, but the noise will not be objectionable. An engine that will give only a thousand miles before making trouble with closely adjusted tappets, can then be driven almost indefinitely without valve trouble if these hints are observed.—RAY F. KUNS.


VALVE MUST CLOSE OR BURNING GASES ESCAPE
Diagram showing correct and incorrect adjustments of valve tappets
TOO MUCH CLEARANCE; VALVE OPENS TOO LATE, CLOSES TOO SOON
CLEARANCE JUST RIGHT .006"
NO CLEARANCE; VALVE CANNOT CLOSE
ADJUSTING NUT
LOCKNUT
TAPPET
CAM

When the clearance is correctly set, the valves rarely have to be ground

FREE—Book on Wood Finishing



If you have a hobby for making porch furniture, radio boxes, cabinets, etc., you will find this Book invaluable. Naturally, you want to give your handiwork a beautiful finish. Our Book gives complete instructions for finishing all wood—hard or soft, old or new. It is the work of experts—beautifully illustrated in color. Gives covering capacities—includes color charts, etc.

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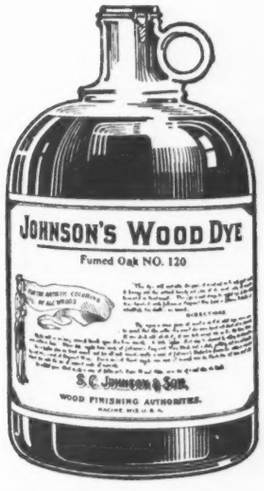
JOHNSON'S WOOD DYE is for the artistic coloring of all wood. With it inexpensive soft woods such as pine, cypress, fir, etc., may be finished so they are as beautiful and artistic as hardwood. Johnson's Wood Dye is very easy to apply—it goes on easily and quickly without a lap or a streak.

JOHNSON'S WOOD DYE comes in all sizes from half pints to gallons. It is made in seventeen popular shades all of which may be easily lightened or darkened. Full directions on every label.



Johnson's Wood Dye has many uses, for both the artisan and amateur. ***Architects*** and contractors specify it for coloring woodwork and flooring in new buildings. ***Painters*** and ***decorators*** use it with equal satisfaction on new and old wood-work of all kinds. ***Housewives*** delight in it for doing over old furniture and for coloring reed and wicker baskets, etc. ***Manual training teachers*** and ***pupils*** use it for finishing their models. ***Upholsterers, furniture repairers*** and ***cabinet makers*** find it "just the thing" for their work—old and new.

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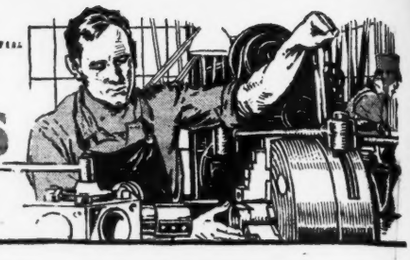
Better Shop Methods

How Expert Mechanics Save Time and Labor



Getting the Most Out of Your Lathe

By H. L. Wheeler

Machine-Shop Foreman

OF ALL the machines in the machine-shop, the engine lathe stands preeminent. It is the most useful and universal machine, and the ancestor of all the machinery in the world today. In the hands of an expert its range and possibilities are almost infinite.

To get the most out of a lathe, it should be located in the shop to the best advantage, preferably near a window facing east or west, or at the point where the best light comes into the shop. The strongest rays should come over the right shoulder of the operator.

Next in consideration should be the foundation. The lathe should rest on a firm floor and be leveled up and in good alinement with the countershaft, and be fastened firmly. The countershaft also must be level; and the line shaft, countershaft, and lathe spindle, parallel. Most of the trouble experienced with countershafts is due to their being out of line with the lathe, not being properly leveled up, or lacking oil.

If the lathe is set up above the ground floor, the floor itself should be firm. If the floor shows any signs of weakness, it should be braced from underneath where the lathe will rest. Long, heavy lathes must be supported on a strong foundation, and it is always best to set them up on the ground floor and have the lathe bed rest directly on a good concrete or brick foundation. The long bed must be supported at several points to prevent sagging.

Another point is the provision of ample space all around the machine so that the operator will be free to pass around and work from all sides.

Whenever a chuck or face plate is mounted, care should be taken to see that chips and dirt have not lodged in the thread. The threaded hole should be wiped out with a clean piece of waste and oiled before it is placed on the lathe spindle.

A chuck or face plate should not be run up to the shoulder suddenly, as that strains the threads and makes it difficult to remove.

One of the common causes of trouble with a lathe is lack of proper lubrication. It is surprising that any machinist should neglect oiling his machines. All oil holes should be oiled regularly with a good grade of machine oil. Special attention should be given the main spindle bearings. Where no regular oiler is employed, the countershaft, as a rule, gets very little attention and not until one of the boxes heats up and sticks does it get any oil. This may cause a four- or five-hour repair job, when it would have been only a five-minute job to oil it.

The ways of the bed and the V's of the saddle need oil as well as the other parts, and this is another point all too frequently neglected. The oil should be rubbed on with the hands and not just squirted on with a can, as it only runs off and is wasted.

It is a common sight to see the ways of a lathe littered up with files, hammers, and wrenches. Sometimes heavy, rough castings are piled on them. This is very bad practice, to say the least, and does not contribute to keeping the lathe in the best of condition. A lathe should be provided with a board that will slide along on the ways in the rear of the tailstock. Such a board is shown in Fig. 6. Simply constructed and costing very little, it will hold all the tools used and any other small articles that may be required for a job. Such small attentions tend to prolong the life of the lathe and keep it in good condition as well as to save much time otherwise wasted in repairs.

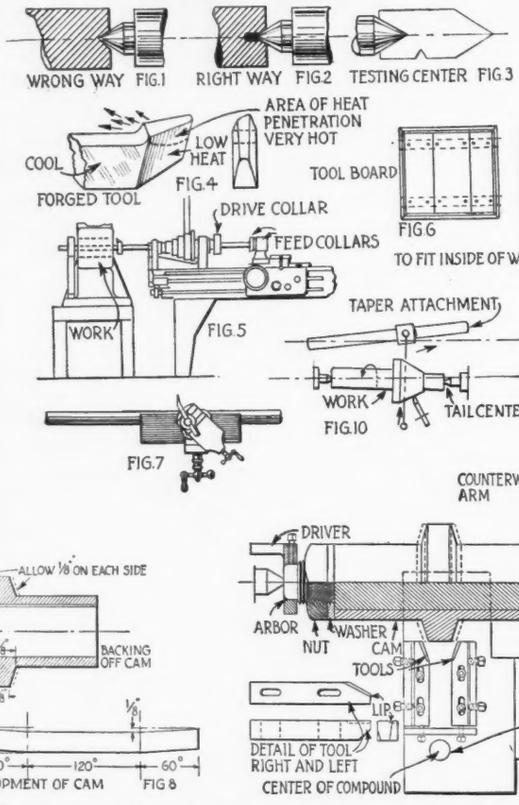
For turning accurate work on centers, it is necessary that the centers run true and in line with each other. The trueness of both centers is tested in the spindle while running at a high speed. Any variation from the true center is usually apparent to the eye. When the centers need to be trued, the best method is to use a toolpost grinder. If one is not available, the hard center will have to be annealed and trued up with a tool.

THE tail center must always be hardened, as all of the wear comes on this center. The centers should always be made of carbon tool steel of about 1.05 to 1.15 carbon. The standard angle is 60 degrees and this angle should never be guessed at when truing up the centers. The proper thing is to test it with a center gage (Fig. 3).

Always make sure that the holes in spindle and tailstock are free from dirt. When centering work, it is best to use a standard combination drill and countersink. This assures the centers being perfect and gives the proper bearing in the work, as illustrated in Figs. 1 and 2.

The tail center requires oil and should never be allowed to run dry. Stop immediately when the center begins to squeal. If heavy cuts are taken on steel shafts, the heat generated by the cut expands the

(Continued on page 94)



Sliding tool table, boring rig, method of turning steep tapers, cam attachment, and other suggestions

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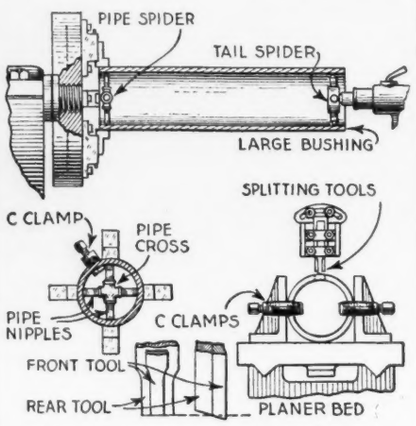
BROWN & SHARPE TOOLS

"The Standard of the Mechanical World"

Machining Large Bushings in Lathe and Planer

THE machining of large bushings is difficult because the thin walls are easily crushed when placed in a chuck. While the rear end can readily be held on a spider at the tail center, the chuck will spring the bushing if it is not reinforced. A light spider for the head end can be made of a pipe cross fitting and four nipples.

In splitting large bushings accurately, care must be taken to have the cutting

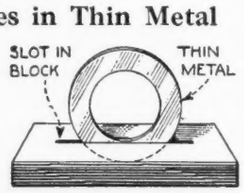


Spider for reinforcing pipe held in lathe chuck and method of splitting large bushings

tool move in a straight line. This cannot easily be done in the milling machine, for one side of the miller is apt to drag, even with a perfect tool. On a planer, the bushing can be split correctly if two tools are used, one in rear of the other. The front tool is the narrower. The bushing is held in place by clamps fastened to four angle plates. This use of two tools prevents chattering and keeps the cut straight, while the clamps prevent the side walls from collapsing.

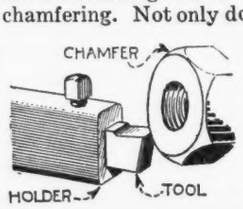
Filing Holes in Thin Metal

WHEN filing a hole in thin sheet metal, I make a slot in a piece of wood with a screwdriver or a blunt tool to take the metal so that the inside of the hole will be flush or a trifle above the surface. With one hand holding the top of the metal, I can file the hole quicker and better than if the work were clamped in a vise.



Facing and Chamfering Nuts

THE facing and chamfering of nuts can be accomplished by the single flat face tool illustrated. One corner is rounded for use while facing and the flat end does the chamfering. Not only does this tool avoid wasting time in changing tools, but it also gives all nuts the same angle, thereby improving the appearance of the work.—E. C. F.



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When you take radio away with you—take Eveready Radio "A" and "B" Batteries, the batteries whose great power lasts longer. Remember, summer's the time when radio signals are weaker.

Batteries do get used up in time. The ones you've been using, though partly exhausted, may be satisfactory for the strong winter signals, but are probably inadequate for the weaker summer signals.

For instance, use the familiar standard 22½-volt Eveready "B" Battery No. 766. It has variable taps for "soft" detector tubes. Put two, three or four in series to provide sufficient power for amplifiers.

To light the filaments of your dry cell vacuum tubes for the longest time, use Eveready Dry Cell Radio "A" Battery No. 7111. The Eveready "A" will astonish you by its long-sustained vigor. It is advisable to use two Eveready "A's" connected in multiple for each WD-11 or WD-12 tube—this gives the economical "eighth" ampere drain per cell which insures maximum economy and longer life. For sets employing one to three UV-199 tubes use three Eveready Dry Cell Radio "A" Batteries No. 7111 connected in series.

The greatest electro-chemical laboratory known created these famous dry-cell batteries on which radio largely depends. The experience of thirty years in battery making stands back of them.

Eveready Radio "A" and "B" Batteries—lively, peppy, long-lived producers of power.

For your light-weight sets to take camping or on hikes, Eveready has suitable small batteries.

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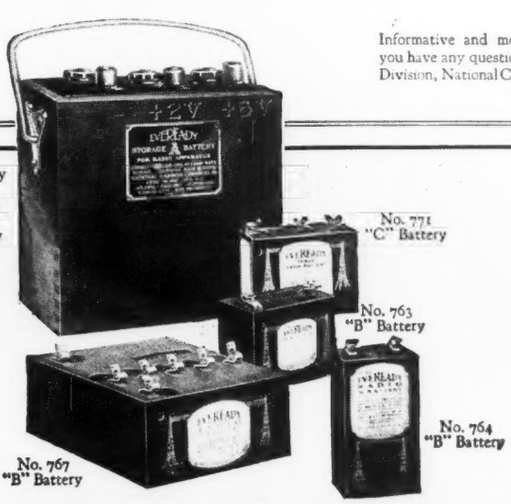

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Write for the Goodell-Pratt Catalog No. 15, which shows the entire line of 1500 Good Tools. It's free.

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How to Remove Broken Taps and Drills Successfully

By John Aures

PERHAPS no machine-shop foreman is better known to mechanics the country over than Old Bill. He is a kindly, keen-witted machinist, ever lending a helpful hand to other workmen. He was a friend of the late Joe V. Romig, who drafted him as a sort of fiction character for a long series of articles planned for the Better Shop Methods Department of POPULAR SCIENCE MONTHLY. This series will be completed by other well-known mechanics, as in the article below.

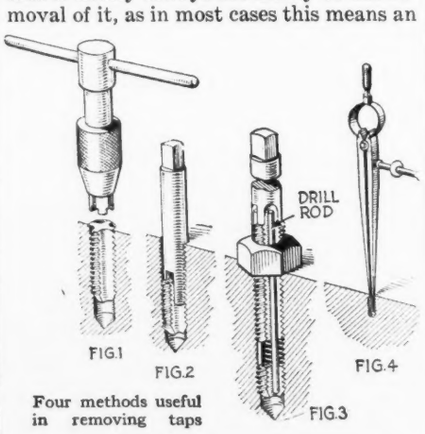
"WHEN are you going to finish that tapping?" inquired Old Bill, the foreman, as he came up to a young mechanic who was pounding away on a cylinder block.

The perspiring youth laid down his punch and hammer, as he turned to the foreman and sadly admitted that he

Old Bill talks on broken taps

couldn't get out a tap he had broken off some time before. With his usual kindliness, Old Bill took the time to tell him the best methods of removing broken taps and drills. The subject is one of such general interest to shopmen, that the substance of Old Bill's lecture is well worth repeating.

Taps and drills break off in work, at times, regardless of what precautions may be taken, as the large breakage in all plants will show. The loss of the tap or drill is nearly always secondary to the removal of it, as in most cases this means an

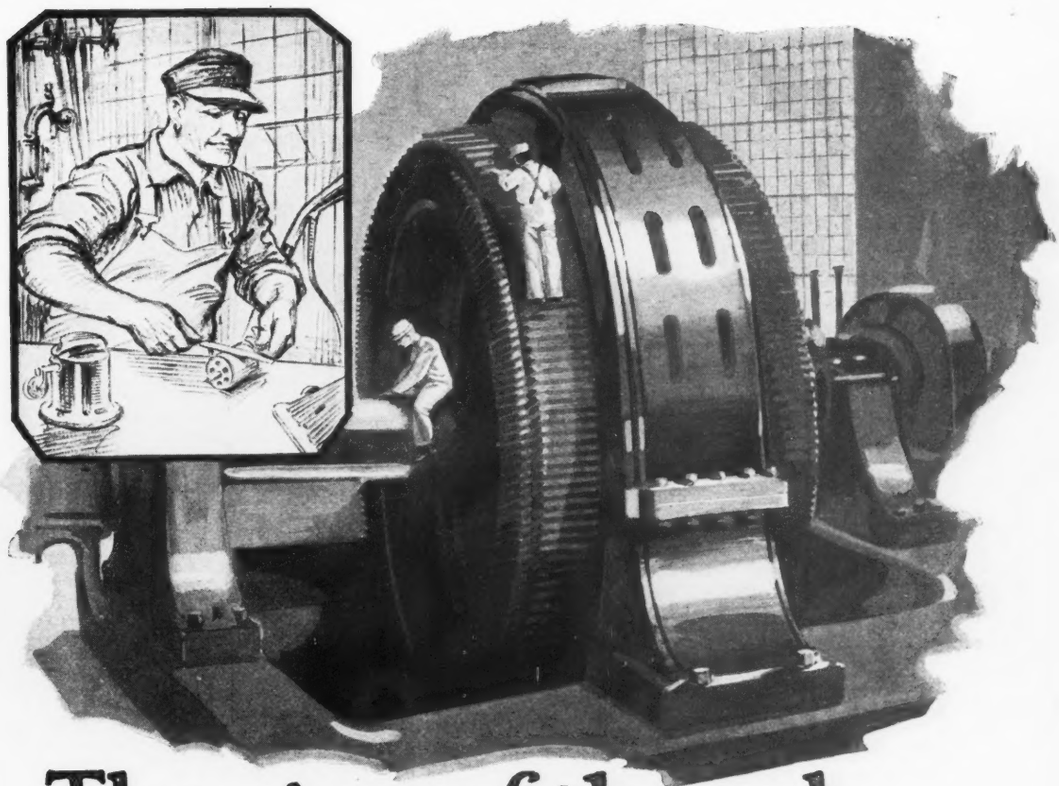


Four methods useful in removing taps

expenditure of much time and patience, particularly where the removal of them is not understood.

Attempts at backing out broken tools of this kind with a hammer and a punch should never be made except as a last

(*Continued on page 86*)



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Let's go back along the Road to Yesterday

SOMEWHERE back among the days of the old swimmin' hole and catfishin' along the river bank, there's *one* day that was long remembered—the day that first toy tool chest came.

Mother probably worried about you sawing up the legs of the old square piano. Dad probably looked on and smoked himself into pipe dreams of your future. And you... why you *knew* you'd grown up.

Why not gratify the liking that you've still got for good tools by including in your tool equipment a Simonds Hand Saw, Hack Saw and File? Simonds cutting tools are backed by 92 years of manufacturing experience. They represent the best of steel, fashioned into the best of tools by the best of craftsmanship.

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SIMONDS SAW AND STEEL CO.
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How to Remove Broken Taps

(*Continued from page 84*)

resource before consigning the part to an annealing furnace.

It is better to try to secure a firm grip on the tap or drill with a tool of some kind. I use one or two tap wrenches of the type shown in Fig. 1. The jaws of the wrench are altered so as to enter the flutes of the broken tap and then rehardened. By tightening the wrench onto the broken tap, it often can be removed easily. A single tap wrench like this can be used on several taps of different sizes. For removing broken drills, a wrench with two opposite jaws removed will have to be used.

Of course, this tool can be used only where the tap or drill is broken off close to the surface of the work, as is usually the case. If the tap is broken off deep in the hole, take a piece of cold rolled steel of suitable size and turn it down to the drill size of the tapped hole. Drill a hole into one end of this the size of the diameter across the flutes of the tap. Notch this end so as to fit into the flutes of the broken part of the tap and case-harden (Fig. 2). Many broken drills and taps can be removed with a tool of this kind.

IF THE tap is broken off so that one side is much higher than the other, grind off squarely the broken part of the tap that is left and run it into the hole as far as the broken-off piece. Turn the tap until the flutes are lined up and insert into each one of them a piece of drill rod of a size that will just fit. Then run a nut the size of the tap over the ends of the drill rods close to the work, as in Fig. 3. If the broken-off piece is not too firmly embedded, it can be removed easily.

Very small taps and drills can be removed at times with a small pair of old dividers, as shown in Fig. 4.

If a broken tap or drill can be worked back and forth and yet not be removed, as often is the case, fill the hole with some diluted nitric (about one to five) or etching acid and work the broken part about occasionally. The action of the acid will help free the broken piece, and it soon can be removed. If a lubricant was used in tapping, it will have to be removed with a strong lye solution before the acid can be used with effect. The hole should be washed out afterward with clear water.

A large tap that breaks near the surface also may be removed successfully at times by two men's tapping on both sides with drifts. Both should start hammering at the same time with light blows and increase the force of the blows gradually. Seldom can a tap be started by driving on only one side.

A TAP sometimes may be broken into small pieces with a punch. When doing this, it is essential to wear goggles to protect the eyes.

When the broken tap will not respond to any of these methods, it may be possible to anneal it with a blowtorch or gas flame, when it may be drilled out. Use a drill of tapping size and be careful to start the drill centrally with the hole.

Another "Old Bill" article, brimful of practical ideas, is scheduled for next month. It is on the secrets of successful thread cutting.

Vincent Lopez and his Hotel Pennsylvania Orchestra

From one who knows

VINCENT LOPEZ praises and endorses the rich, clear, natural quality of MUSIC MASTER reproduction. His Hotel Pennsylvania Orchestra is heard over the radio by untold thousands.

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Please accept my heartiest congratulations.

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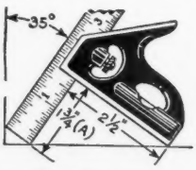
Laying Out Angles with an Ordinary Combination Square

WHEN your toolkit lacks a high-priced bevel protractor, your trusty old combination square will serve accurately enough for ordinary work.

Suppose you need an angle of 35 degrees and the distance from the edge of the blade to the end of the combination head is 2½ in. Then set the head at the 1¾-in. mark, as shown, rest the tool on a flat surface, and the blade will stand at 35 degrees from the perpendicular.



How the square may be used

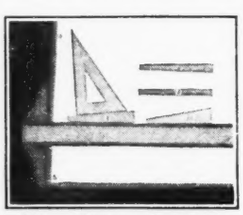
For common angles the distance *A* (with 2½ in. squares only) should be as follows:

5° - 7/32 in.	35° - 1¾ in.
10° - 7/16 in.	40° - 2 7/64 in.
15° - 43/64 in.	45° - 2 ½ in.
20° - 29/32 in.	50° - 2 63/64 in.
25° - 1 11/64 in.	55° - 3 37/64 in.
30° - 1 7/16 in.	60° - 4 21/64 in.

For any angle not found in the table, a simple calculation for the length of the leg for the desired angle will enable you to set the square correctly.—BION R. WICKS.

Set of Four Extra Angles Speed Draftsman's Work

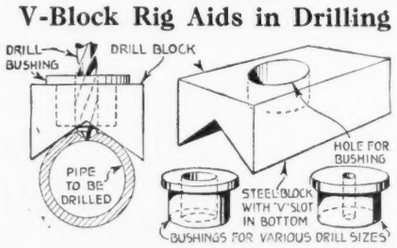
BY ADDING four homemade angles to his set of drawing instruments, a draftsman can obtain any angle from 1 to 90 more quickly and conveniently than with the protractor usually used.


The additional angles

The extra angles are two of 2 degrees, one of 5 degrees and one of 10 degrees. For ordinary use they should be about 1/8 in. thick, 5/8 in. wide at the narrow end, and 6 or 7 in. long.

Used singly, collectively, or in connection with the regular 30/60 and 45 degree triangles, they make possible the solution of any of the more common problems in angular work. For example, two 2-degree angles with a 5-degree angle reversed give an angle one degree from the horizontal. When placed against the square side of a triangle, they indicate 89 degrees.—E. W. C.

V-Block Rig Aids in Drilling

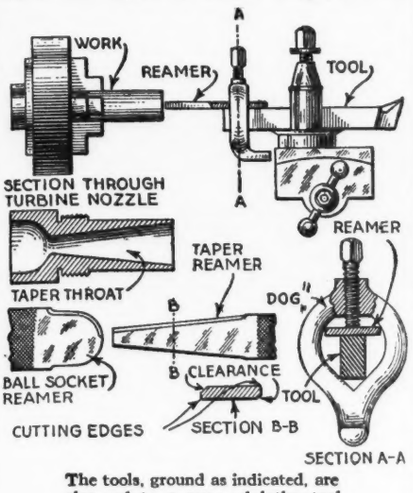


DRILLING round bar stock or pipe is simplified by using the drill centering tool illustrated. It holds the drill so that the hole will be accurately centered.

A series of graduated bushings are made to fit the hole in the V-block so that drills of different sizes may be used.

Flat Reamers and Internal Tools Made from Files

A FLAT file often will provide the material for making a reamer that is needed immediately to suit a special job. The teeth on the fore end of the file are ground off for a sufficient distance and both sides are made flat and true. Then the taper or shape is ground as



The tools, ground as indicated, are clamped to a reversed lathe tool

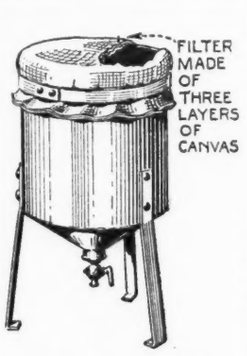
desired. If straight sides are required, a universal grinder can be used.

The cutting edges are next cut, as shown. The sides are ground at right angles to the faces and the relief is ground only on the rear corner. This gives the proper angle for a fine finish and prevents chattering. Clearance behind the cutting edge should be held down to a minimum.

The reamer is held on a reversed lathe tool, as indicated. It should lie flat and central with the bore and be properly alined by moving the cross slide in or out. Special internal tools for forming the bottom of holes can be made in the same way.

Reclaiming Crankcase Oil

THE oil filter illustrated was devised in a southern Maryland garage for reclaiming oil from crankcases of automobiles. This oil is sold to farmers in the neighborhood for use on mowers, threshers, and other rough machinery.



The filter is made from a 5-gal. oilcan

The filter consists of a 5-gal. oilcan, supported on wrought-iron legs about 2 ft. above the floor. Three layers of closely woven canvas form the filter screen. These are held in place by a hoop. A petcock is soldered at the bottom of the can for drawing off the filtered oil. The screens are removed occasionally and washed in gasoline to remove the sediment.—A. L.

You Men Are Alike

When I learned what 1,000 men wanted in a Shaving Cream, I knew what millions wanted

By V. K. Cassady, Chief Chemist

GENTLEMEN:

I asked 1,000 men what they most desired in shaving cream.

We worked 18 months to perfect for you the ideal shaving cream. We made up and discarded 130 separate formulas.

After 130 trials, we made a shaving cream which no man yet has matched. It excels in lather, in quickness, in durability. It excels in fine after-effects. It excels above all, in strong bubbles.

5 things you wanted

It multiplies itself in lather 250 times, so a tiny bit suffices for a shave.

It acts in one minute. Within that time the beard absorbs 15% of water.

It maintains its creamy fullness for ten minutes on the face.

Super-strong bubbles support the hairs for cutting. No hairs falling down.

The palm and olive oil blend leaves fine after-effects. The soap itself is a cosmetic,

We ask a test

This is not written to sell you Palmolive Shaving Cream.

We ask a test at our cost—a ten-shave test. We will then accept your verdict. Please, in fairness to yourself and us, mail this coupon to us.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream.

PALMOLIVE SHAVING CREAM

© P. Co., 1924

10 SHAVES FREE

and a Can of Palmolive After Shaving Talc

Simply insert your name and address and mail to:

Address for residents of Wisconsin, *The Palmolive Company*, (Wisconsin Corporation) *Milwaukee, Wisconsin*, Dept. B-738. Address for residents other than Wisconsin, *The Palmolive Company* (Delaware Corporation), *360 North Michigan Avenue, Chicago, Ill.* Dept. B-738

No. 2674—*Eveready 3-cell focusing spotlight with 300-ft. range.*

On your vacation —*use your flashlight!*

Put it in the grip for the trip. Near the top. You'll use it going, while you're there, and on the way back. Synthetic sunlight! It makes night safe. Wind or rain can't put it out.

Hundreds of uses, indoor and out. Mountain or seashore or lake. Use it as a pathfinder after dark. Use it for signaling. Use it to investigate night noises. Keep it handy. Tie a tape around it and hang it within reach.

Better still, take along several Eveready Flashlights—a focusing spotlight for long-range use; a broad-beam flashlight for close-ups; an aluminum flashlight of pocket size. The newly designed and improved line is ready—twenty-two fine flashlights in four general types, for every purpose and purse. New designs. New features.

See that they are loaded with fresh, strong Eveready Unit Cells—long-lived cartridges of brilliant light. Eveready Flashlights are still 65 cents to $4.50 complete with battery—anywhere in the U. S. A. Buy the improved Eveready Flashlights from electrical, hardware and marine supply dealers, drug, sporting goods and general stores, garages and auto accessory shops.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC., New York—San Francisco
Canadian National Carbon Co., Limited, Toronto, Ont.

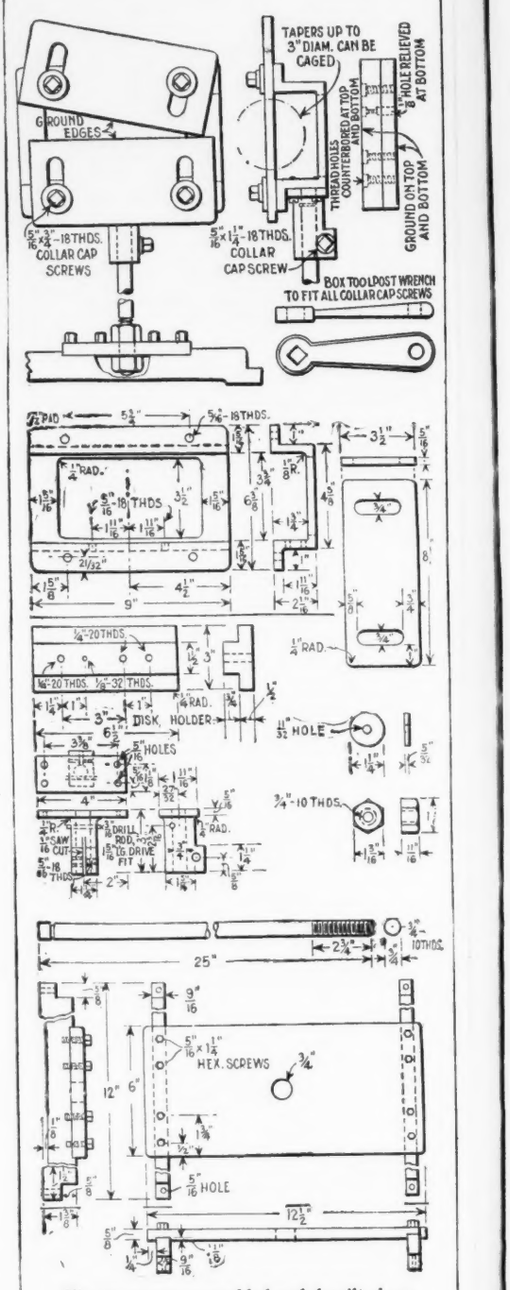
EVEREADY UNIT CELLS fit and improve all makes of flashlights. They come in two sizes to fit every tubular flashlight case. Know the Eveready size that fits your case. Then you can buy new Eveready Unit Cells without bothering to take your flashlight along. Eveready Unit Cells mean brighter flashlights and longer battery life.

EVEREADY
FLASHLIGHTS
& BATTERIES
–they last longer

Gage Insures Close Accuracy in Testing and Fitting Tapers

GAGING the trueness of a taper by the visibility method is an accurate and rapid way. This can be done by means of the simple fixture shown below.

A block is drilled and tapped as indicated in the upper right-hand corner of this illustration and in the drawing on the following page. This block holds a pair of buttons at intervals of 1, 2, 3, and 4 in.,



The taper gage assembled and details showing dimensions that have proved satisfactory

as necessary. The disks are turned and hardened and ground according to the degree of accuracy wanted and are of the proper diameter so that when two lines are drawn tangent to both disks, they will lie on the exact taper.

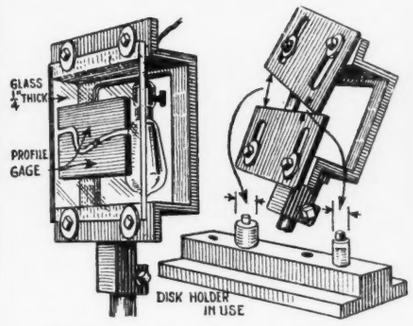
The plates on the gage proper, the construction of which is made clear in the

(*Continued on page 91*)

Gage Insures Close Accuracy

(*Continued from page 90*)

accompanying details, are loosened and placed so that they will be tangent to the two disks, and the cap screws are tightened. The gage is then placed on the bench in front of a window or an electric light. The taper to be tested is placed in the space between the plates. When the



How the gage is used for checking tapers and testing and fitting irregular profiles

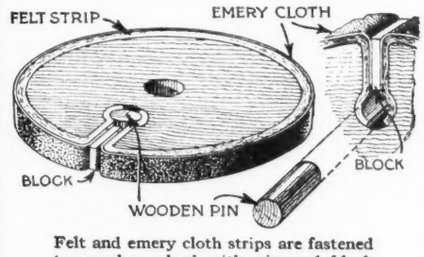
taper is correct, there will be no light visible at the ground edges of the gage. These edges also may be covered with Prussian blue so as to leave an imprint on the high spots of the work.

Any two disks can be used to give three or more combinations of tapers by fastening them at different points on the disk holder.

The gage also may be used for fitting profiles. A piece of glass then is fastened to the face of the fixture in place of the gage plates; the pieces to be fitted are placed upon the glass, and the mechanic has both hands free to fit them.—H. S. L.

Simply Made Polishing Wheel

THIS polishing wheel is designed for tools, punches and dies, and other hardened steel surfaces. The wheel proper is turned from a piece of hardwood 2 in. thick and 12 in. in diameter, having a central hole to fit the shaft and a radial



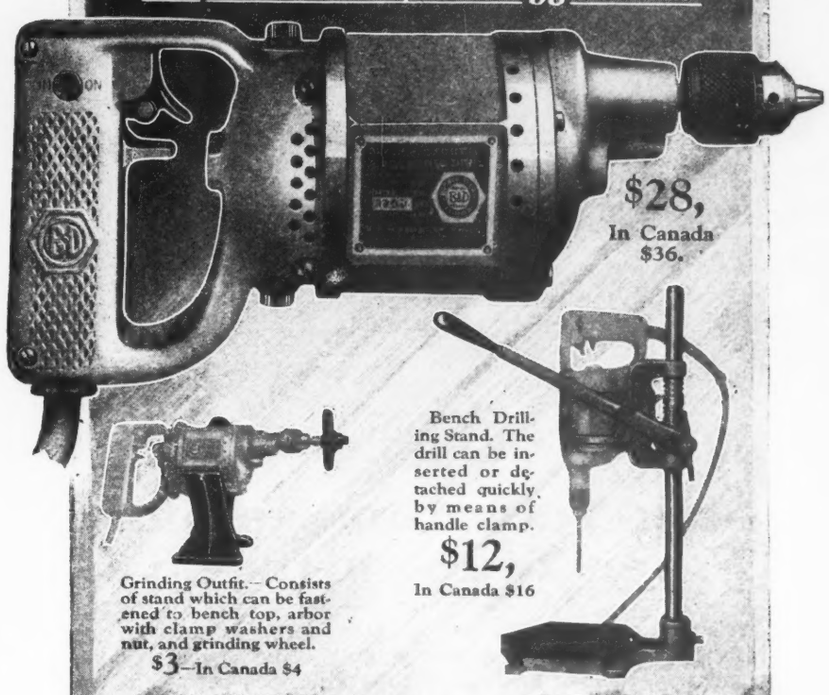
Felt and emery cloth strips are fastened to wooden wheel with pin and block

slot ending in a hole drilled near the edge. A strip of felt is tacked on the outside to serve as a cushion for the emery cloth and the ends project into the slot. A strip of emery cloth 2 in. wide and of the same length is laid over the felt.

A wooden pin and small block are used to bind the emery cloth tightly on the wheel and hold it in place.—F. J. W.

PIPE threading dies should be lubricated with a good quality of lard or crude cottonseed oil, the lubricant being used in liberal quantities. Ordinary machine oil should never be used.

BLACK & DECKER
QUARTER-INCH PORTABLE ELECTRIC DRILL
"With the Pistol Grip and Trigger Switch"



$28, In Canada $36.

Grinding Outfit.—Consists of stand which can be fastened to bench top, arbor with clamp washers and nut, and grinding wheel. $3—In Canada $4

Bench Drilling Stand. The drill can be inserted or detached quickly by means of handle clamp. $12, In Canada $16

The Most Useful Tool

The following letter, dated January 30, 1924, was received from Howard Vincent O'Brien, Winnetka, Illinois:

January 30, 1924.

Black & Decker Mfg. Co.
Dear Sirs:
The following article was submitted in a competition to Popular Science Monthly, and not used.
It occurs to me that you might find some use for it—the drill in question being a ¼" Black & Decker.

Very truly,
HOWARD V. O'BRIEN.

"I don't think there can be much argument as to which is the most useful of all tools. The knife is man's greatest refinement upon nature—all other tools are but improvements as to ease and speed.

"But next to the knife I would place the electric drill. It does more different kinds of work, with less energy and more speed, and with higher quality, than any other tool.

"Aside from boring holes, with reaming, counter-sinking, and even, at a pinch, screw-driving, it is available for simple lathe work in wood or metal. I have even arranged mine for milling, and, with the same simple fixture, for plain and surface grinding.

"Slipping a home-made router in the chuck, I have quickly turned out jobs tedious indeed with mallet and chisel.

"With the proper table, it becomes a circular saw. And with guides and a handle fitted, it can be used for all kinds of grooving.

"Its portability makes it a family as well as a shop treasure. With emery and sand-paper discs, wire brush, buffing wheel and crocus, everything from scouring pots to polishing door-knobs is feasible.

"And finally, by slipping on a pulley, and equipping it with a clamp, it becomes a self-contained power plant, available for the sewing-machine, the coffee mill, or the children's toys.

"I am quite sure that no one who has once enjoyed its countless blessings, would lightly part with it."

Orders and inquiries may be mailed to

THE BLACK & DECKER MFG. CO.
700 Pennsylvania Avenue, Towson, Maryland

SHALER
5 MINUTE VULCANIZER

Ask Your Garageman When You Stop for Gas!

When you tank up with gas for that long trip ask the garageman about the handy 5-Minute Vulcanizer. He will tell you that he never dreams of traveling country roads without carrying the convenient Shaler for emergency roadside repairs. Take a tip from him. He knows from experience that *vulcanized* patches are the only ones that last.

Don't forget—there's no substitute for the Shaler for fixing tube punctures because there's no substitute for vulcanizing with heat. It's quicker than changing tubes—and so much easier than sticking on temporary cold patches that soon loosen and come off. That's why more than two million motorists use it and recommend it to their friends.

How It Works

The Shaler is very simple and easy to use. A special Patch-&-Heat Unit is used for each repair. Each Unit consists of a metal pan containing solid fuel, with a piece of raw rubber attached underneath. Simply clamp a Unit over the puncture, and light the fuel. After five minutes take off the pan and throw it away. That's all. The tube is ready to use. It's vulcanized—as good as new.

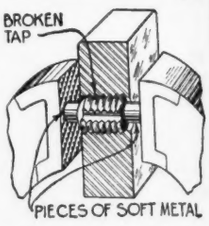
Complete Outfit Costs Only $1.50

Slightly higher in Canada and Far West.

The Complete Outfit includes the handsomely nickel plated vulcanizer and 12 Patch-&-Heat Units (6 round for punctures and 6 oblong for cuts and tears) packed in a small box ready to carry in your car for an emergency. All garages, auto accessory and hardware stores carry the 5-Minute Vulcanizer in stock. Get one for your car.

C. A. SHALER CO., 2102 Fourth St., Waupun, Wis.

A Vise Aids in Removing Taps

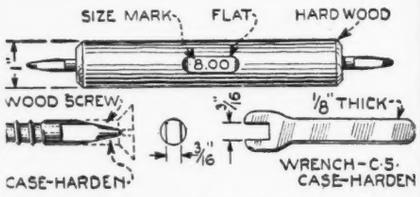


WHEN a tap has broken off in a hole and the character and size of the work permit, I have often extracted the tap by placing the work between vise jaws, as shown, and using two pieces of soft steel or brass smaller than the tap hole in diameter to grip the tap from both ends. When the jaws are tightened, all that is necessary to loosen the tap is to turn the work by hand.—E. E. LAKSO, Fitchburg, Mass.

Cheaply Made Measuring Points for Large Work

A HANDY measuring rod may be made from a discarded broom handle, or any round, hardwood stock, and two wood screws. The point is turned on each screw by holding in a spring chuck; the flats are milled. The points are then case-hardened.

The points may have a total movement of about 1 in. Holes should be bored in



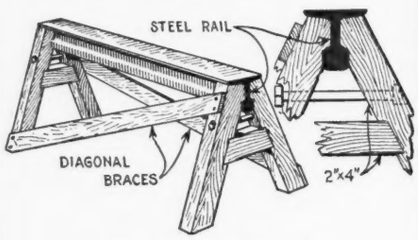
Two wood screws with case-hardened points are inserted into a hardwood handle

the stick before the screws are turned in and a little soap should be used on the screws.

When set to a micrometer, the points will retain their accuracy for an indefinite period, provided the wood used is well seasoned. If they are to be used frequently, a small wrench made as shown will be more convenient than an adjustable wrench for making adjustments.

Steel Rail Serves as Useful Straightening Fixture

A FOUR- or 5-ft. length of steel rail, mounted on trestle legs, as shown, serves as a useful straightening fixture.

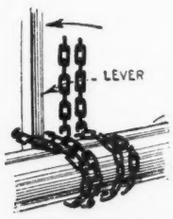


Heavy legs like those of a sawhorse support the steel rail

The legs are made from two-by-fours, strongly crossed, braced, and bolted. It will be noted that there is no necessity for drilling holes in the rail, and the fixture, therefore, can be put together quickly.

Crowbars and Chains Take Place of Heavy Wrenches

TWO lengths of chain and two steel bars, used as shown, will take the place of heavy pipe tongs in an emergency for screwing or unloosening large pipe fittings. The free ends of the chains are held in one hand while the lever is manipulated with the other. Enough turns of the chain are taken to prevent slipping, and to take a new hitch on the pipe it is necessary only to slacken the chains a trifle.

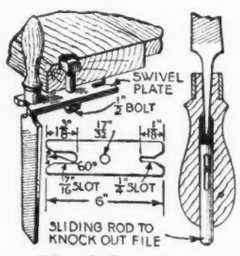


For turning heavy pipe and fittings

This method has been used in disassembling iron pumps in which the threads were thoroughly rusted, and it is a useful means of handling heavy work when regular chain wrenches are not available.

A File Handle Jack

MECHANICS working at the bench who frequently have to change their files will find that a file jack made as shown is a time saver. It is made from a 6-in. length of flat iron 2 in. wide and is like a miniature bootjack. Slots are provided at each end and the fixture is bolted to the under side of the bench.



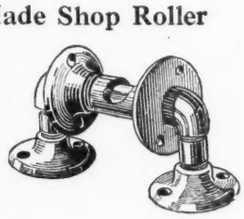
The jack and a handle "knockout"

The tang of the file is slipped into one of the slots and the file pulled out with a jerk. When not in use, the jack is turned parallel to the edge of the workbench.

Another method of accomplishing the same result is to insert a knockout rod in the handle of the file. The file then is loosened simply by tapping the end of the rod against the bench.

Cheaply Made Shop Roller

WITH only standard pipe fittings, a durable and efficient roller can be made for handling heavy and bulky pieces of lumber and steel. It has been used in handling lumber going to and from the saws; for steel bars, for fire hose, and for many other shop purposes.—W. T. M.



Erasing Drawing Ink

QUITE by accident I found that I could erase a commonly used brand of black drawing ink from tracing cloth by applying spirits of camphor. Place blotting paper under the tracing and do not rub too hard.—F. N. C.

General Motors Trucks

Cost of Manufacture Sets GMC Price

GMC price represents only the actual physical cost of manufacture plus a reasonable profit—no surplus price camouflaged as trade-in value—no extras.

GMC trucks are built from the finest materials by expert workmen and according to a design that provides unsurpassed efficiency and economy. They embody special GMC features which definitely increase their earning power, lessen their cost of operation and lengthen their lives.

Yet GMC price is remarkably low in comparison with this unusual service. It is only possible because of economies in the purchase of materials and in manufacturing methods that come through the advantages enjoyed by General Motors Truck Company as the exclusive truck building unit of the General Motors Corporation.

Such hauling service at such a low straight forward price is of vital interest to truck buyer and dealer alike. Write for complete information about GMC trucks.

GENERAL MOTORS TRUCK COMPANY
Division of General Motors Corporation
Pontiac, Michigan

GMC

General Motors Truck Co.
Pontiac, Michigan
Department 47

Gentlemen:

Please send me further information. I am interested in a (truck) (dealership).

Name.....

Address.....

The Road to Home

Though written faithfully, his letters from home seemed to have had a way of arriving at his hotel in one city just after he had left for the next—and of never catching up.

Three weeks passed—business conferences, long night journeyings on sleepers, more conferences—with all too little news from home.

Then he turned eastward. In his hotel room in Chicago he still seemed a long way from that fireside in a New York suburb. He reached for the telephone—asked for his home number.

The bell tinkled cheerfully. His wife's voice greeted him. Its tone and inflection told him all was right with the world. She hardly needed to say, "Yes, they are well—dancing right here by the telephone. . . . Father and mother came yesterday. . . . Oh, we'll be glad to see you!"

* * *

Across the breadth of a continent the telephone is ready to carry your greetings with all the conviction of the human voice. Used for social or business purposes, "long distance" does more than communicate. It projects you—thought, mood, personality—to the person to whom you talk.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

BIASCOPE $5
Pocket Binocular

brings distant objects near on land, on sea or in the air. For motoring, nature study, every outdoor use.

$5 and $7 at dealers. By mail add 25c. Money-back guarantee. Circulars free.

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Lace Leg Breeches
Maker to Wearer

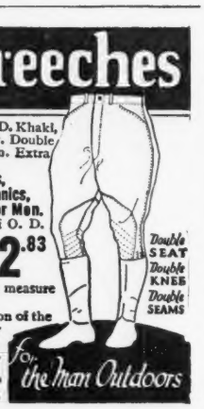
Direct from factory to you; O. D. Khaki, Duck, Moleskin and Corduroy. Double seat; double knee; double sewn. Extra belt loop in back.

Sportsmen, Campers, Tourists, Farmers, Chauffeurs, Mechanics, Engineers—all Outdoor Men.

OUR LEADER, shower proof O. D. Duck Breeches, soft pliable fabric, made for hard wear. $2.83
Add 25c for reinforced knee. Add 8c for postage . . .
Give waist measure and inside measure from crotch to shoe top.

FREE Samples with description of the many styles we make. Money back guarantee with every sale. Ref.: 1st. Natl. Bk., Rome, Ga.

OUT-OF-DOORS PANTS CO.
Dept. 27 Rome, Ga.



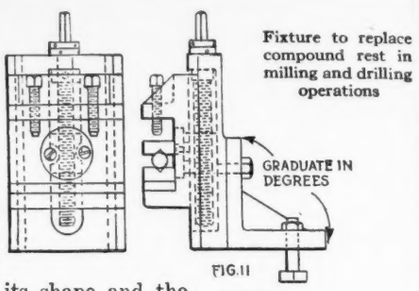
How to Get the Most Out of Your Lathe

(*Continued from page 80*)

shaft lengthwise and causes it to bind on the centers. This must be watched very closely, for if the work becomes too tight, the center will get hot enough to twist off and drop the work.

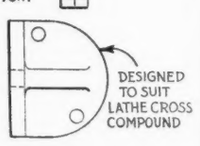
It long has been a custom with many machinists to straighten shafting on lathe centers. This is very bad practice and I often wonder why it is continued in any shop. The centers hardly ever will run exactly true after straightening a shaft, and it injures the lathe in other ways.

There always has been considerable controversy in regard to the proper form for lathe roughing tools and the way they should be ground. However, the efficiency of a lathe tool depends very much upon its shape and the way it is ground to suit each material. For small variety work, the writer has found tools of a well-known patented type to be the most economical all-around tool. For heavy machine work, forged tools of high speed steel are still the most popular, especially for heavy cuts.



Fixture to replace compound rest in milling and drilling operations

FIG. 11



A good shape for a roughing tool is shown in Fig. 4. This form has been tested in competition with several other forms and has shown advantages over any others I have seen. One of its particular advantages is its ability to eliminate rapidly the excessive heat generated by heavy cuts and coarse feeds. This lengthens the time between grindings and incidentally increases production.

Friction aided by heat is what breaks down the cutting edge of a tool. Consequently, the more rapidly this heat can be taken away, the longer the tool will last. This tool is so made that heat generated at the point is quickly broken off a short distance away and only a small part of it is retained in the body of the tool.

The efficiency of a turning tool also is affected by its position. The point should not be any farther away from the toolpost than is absolutely necessary, and for most work it is best to have the point slightly above the center. When taking very heavy cuts, the tool should be set so that the point inclines slightly toward the tailstock or away from the cut, rather than in the direction of the headstock. When set in this manner, it will be impossible for the tool to cut under the size set, should there be a tendency for the toolpost to loosen.

An engine lathe often may be rigged up with a few simple accessories to turn out manufacturing jobs at a cost to rival that

(*Continued on page 95*)

How to Get the Most Out of Your Lathe

(*Continued from page 94*)

of a high-priced special machine. And it need not be idle when the job is finished, for you always have your engine lathe for general work, whereas a special machine may lie idle for considerable periods.

Figure 10 illustrates an unusual method for turning a steep taper on a lathe equipped with a taper attachment so that the power feed may be used. This method is recommended for repetition work. The taper is set by the cut-and-try method.

The cam turning job (Fig. 8) shows the possibilities of the lathe as a cam cutter and for other irregular work. The special arbor and tool attachment used (Fig. 9) are designed for manufacturing.

THE master cam is a separate piece keyed to the arbor, and the cam blank is fastened on the arbor by a hex nut and washer. The tools are supported by a simple flat casting, which is bolted to the compound rest. This casting is provided with ribs on each side of both tools and at the back, and the tools are adjusted by means of setscrews on the side and at the rear end. Two cap bolts passing through elongated slots in the tools serve to hold the tools rigid while turning.

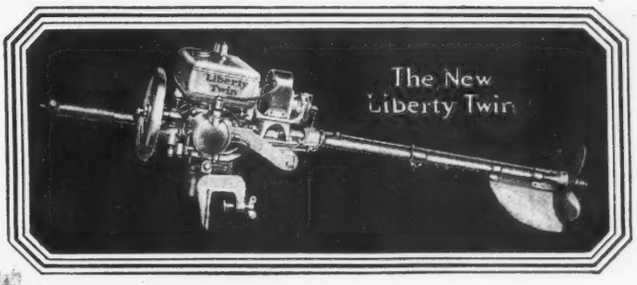
The counterweight arm is made from a straight piece of bar iron bolted to the side of the compound rest. It may be necessary to make a short bend in this arm so that it will pass under the arbor. The tool is actuated by the roller, which is held against the master cam by the counterweight.

Figure 5 shows how it is possible to handle a large boring job in a small shop. The job is to bore a hole or several holes, as the case may be, in large heavy castings or similar work. The work may be supported by building a crib of heavy timber or any other improvised method at the end of the lathe. It is leveled up, located for position, secured by lag bolts or some other means, and braced so that it will not move. The boring bar passes through the hollow spindle and carries a collar in which the tool is fastened by means of a setscrew. The bar is driven by a second collar screwed on to the spindle in place of the chuck. The hole in this collar should be a sliding fit for the bar and be fitted with a feather key, which engages a key slot in the bar for driving. The end of bar is fitted with collars and is held in place by a casting bolted to the compound rest. This arrangement serves to feed the bar toward the work. The end of the bar is supported by an improvised steady rest.

WHEN cutting threads, it will be found convenient to have the compound set at an angle of 60 degrees, as shown in Fig. 7. This makes it easy to remove the tool for grinding and reset it without disengaging the nut, and the thread then is "picked up" more easily than it would be if the compound were straight.

In facing off, it is also a good plan to set the compound at an angle with the work and lock the carriage. The tool may be fed into the work with the compound, and

(*Continued on page 96*)



Our Challenge
to other builders to follow us through weeds, shallows and over sunken obstructions has never been accepted and still stands.

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The Caille Liberty Twin is the only motor that will drive your boat anywhere it will float. It is the only motor that will take you through weeds so thick you couldn't even row—through water so shallow a boat will scarcely float—over hidden obstructions that will just permit a boat to pass. It's the only motor that drives your boat well up on shore when landing and can be attached on shore when starting out. It's the only motor that gives you 100% use of your boat.

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is the only outboard motor built on the Direct Drive principle. The drive shaft extends straight out from the stern of the boat and the motor is pivoted and so perfectly balanced that the slightest contact with hidden obstructions causes it to rise and pass over. The propeller of the vertical so-called "tilting type" motor receives a 60-pound blow before it will tilt. Furthermore the Liberty Twin has no bevel gears to wear, give trouble and require packing in grease.

Has Bosch Magneto

Standard the world over on high class motors. Mounted on a special rocking cradle designed by Caille and Bosch engineers, it gives a uniformly hot spark at all speeds.

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Simply turning the grip on the steering handle adjusts the timing of the hot Bosch spark and controls the speed of the motor. Pressing button on end of steering handle stops motor.

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Specially designed for the Caille Liberty Twin. Operates automatically at all speeds without any adjustment whatever. No needle valves to fool with. Proper mixture of gas is always assured.

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The telescoping shaft can be quickly detached to facilitate carrying. Motor comes in chest having convenient handles. Can be shipped anywhere or carried on running board of car.

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Ask for Measuring Chart to assist you in figuring value of all outboard motors. And remember, when you buy a Caille motor you get the product of a pioneer in the industry—a manufacturer that is firmly established and will be in business through the years to come to supply you repair parts should you ever need them. Send for details today. Send the coupon to nearest address.

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This handy tool converts your bench Vise into a Pipe Vise. Or it can be used as a hand clamp for holding any pipe or round object while drilling or threading. Its ribbed jaws grip pipe securely. Clamping Jaw holds round stock, ¼ to ¾ inches. This tool has many uses and costs very little.

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If there is such a thing as a 100 per cent all-purpose Cold Chisel, Vlchek makes it. Made of Vanadium steel, tempered by the advanced Vlchek process, they are tools of extraordinary quality and life. Tempering is neither too hard to cause chipping or soft enough to cause the edge to turn. Cutting edge is oversize—added strength, greater cutting surface.

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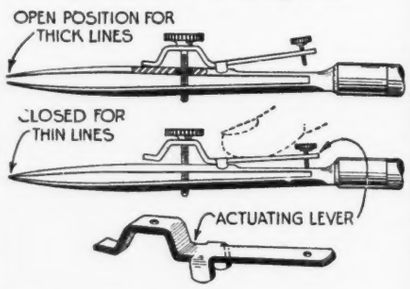
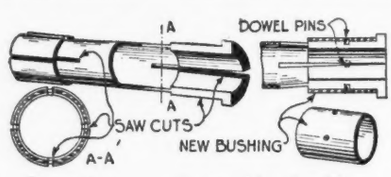


WHEN a draftsman has to do cross-sectioning that consists of light and heavy lines or a large amount of conventional line shading, he will find it pays to use on his ruling pen the special attachment illustrated. This is set so that the pen normally will draw a thick line, but when the lever is pressed lightly with the forefinger, the pen closes for drawing the thin lines. A common type of cleaning catch used on some ruling pens can be used for the same purpose.—W. A. P.

Repairing a Large Bushing

I HAVE repaired bushings for the spindles of an automatic multiple spindle screw machine in the way illustrated, which is also useful for renewing badly worn spindle bushings of lathes and other machines.

Cut four longitudinal slots in each end of the bushing as indicated. In this case



Renewing expensive machine bushings

the slots were 4 in. long. Two short bushings then are made of any suitable material and pressed on the worn bushing to compress the metal sufficiently to allow it to be rebored.—JOHN LARSON.

How to Get the Most Out of Your Lathe

(*Continued from page 95*)

the face will come out much straighter.

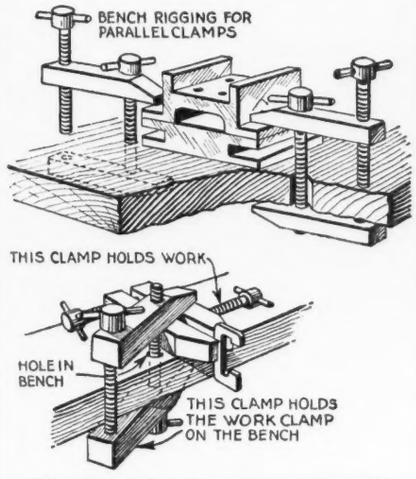
The engine lathe is capable of performing many milling operations, such as cutting key seats in shafts, milling square ends, slotting screwheads, cutting small gears and the like. The fixture shown in Fig. 11 (page 94) is attached to the saddle in place of the compound rest and will be found useful for many jobs of this character. A set of V blocks may be used for holding shafts and other round work. The fixture is also useful in drilling.

In regard to drilling in the lathe, it is worth noting that practically any kind of a job that the drill press will handle may be done in the lathe, but this is not to be recommended except in a small shop.

ANOTHER article on the lathe is scheduled for early publication in the Better Shop Methods Department. It will give a number of lathe short cuts that frequently can be used to save time and labor.

How to Make the Most of Parallel Clamps

PARALLEL clamps often can be used to advantage in holding work on the bench for fitting or laying off and in



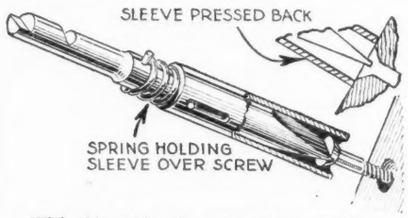
Holes through bench permit use of parallel clamps in the two ingenious ways shown

fastening small parts in the most convenient position and the best light.

By boring several holes in the bench top, one or more clamps can be used as shown in the upper illustration. To hold small work at the edge of the bench, one clamp grips the work while the other clamp fastens down the first, as indicated in the lower drawing.

Non-Slip Guide for Automatic Screwdriver Speeds Up Work

AN ATTACHMENT for use with an automatic screwdriver, which will greatly speed up the work and prevent slipping of the blade, can be made very simply. It consists of a sleeve to fit the tool, a peg fastened to the blade and



With this guide, the automatic screwdriver blade immediately enters the screw slot

sliding in a groove in the sleeve, a small spring to keep the sleeve projecting beyond the end of the tool, and a peg against which this spring bears.

When the sleeve is placed over the screw head and pressure is brought to bear on the handle, the end of the blade quickly finds the slot in the screw head and the screw can be driven home. The spring allows the sleeve to slide back upon the tool when making the last few turns. —WALTER T. MARKOWSKI, Camden, N. J.

HEAVY sheet brass may quickly be reduced to paper thickness for thin gaskets, shims, and the like, by dipping it repeatedly for a few seconds at a time alternately into nitric acid and then into water.

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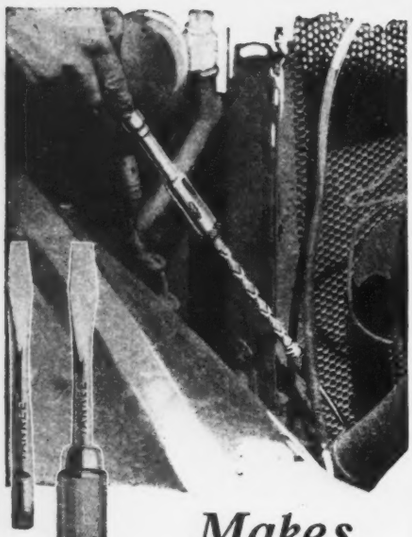

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Unscrewing an old hose clamp, or screwing tight a new one is an unhandy job unless you use a

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It does the work for you. All you need to do is to place it in the screw slot of the clamp bolt and push.

The live spring in the handle shoots the handle back quick for the next push. Its long reach prevents barked knuckles.

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"Yankee" Spiral Ratchet Screwdrivers, without the quick return feature, No. 30 A, No. 31 A, No. 35.

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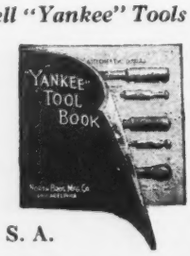

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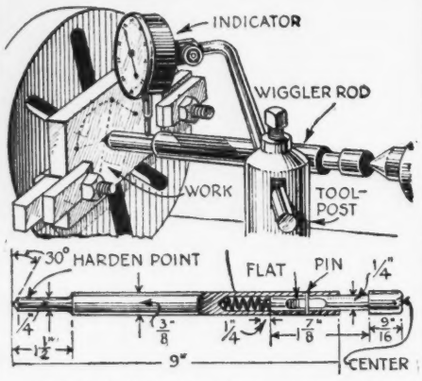
Make Better Mechanics

Accurate "Wiggler" Rod for Use with Indicator

TO LINE up punch marks when setting work to be bored in the lathe and milling machine, a "wiggler" rod with indicator is an invaluable aid for accuracy to within .005 in. The point of the rod is inserted in the center punch hole in the work while the other end turns on the tailstock center. Any movement of the rod as the work is turned indicates that the mark is off center. The work is then gradually brought into line. By amplifying the rod movements with the indicator, accurate results are certain.



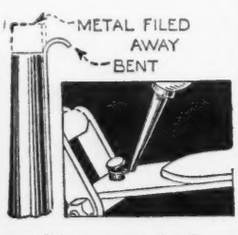
Details of the rod and how it is used with an indicator for centering work accurately

The rod may also be used in a milling machine by holding a center on a line with the punch mark on the work. The work is then brought in line in the same way as for lathe work.

The spring must be sufficiently strong to hold the ends of the rod firmly against their seats. There must be no lateral play of the end slide in its hole and the end centers must be truly on the axis of the rod, with no rough spots on the surface of the rod that would cause false movements on the indicator.

Hook on Oilcan Spout Lifts Spring Dust Caps

UNNECESSARY soiling of the hands while oiling the generator, starting motor, and other parts of automobiles can be avoided to some extent by using the tip of the oilcan to lift the spring caps over the oil holes. Part of the metal at the tip of the oiler spout is filed away and the remainder is turned over to form a hook. This hook will hold up the lid while oil is injected into the hole.—G. L.



Oilcan spout hook

FOR cleaning brass castings an effective solution is made by mixing sulphuric acid, three parts, and nitric acid, two parts. A handful of ordinary salt should be added for each quart of the solution. The mixture must, of course, be kept in an earthenware receptacle.

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(Signed) H. J. Fisher, *Publisher.*

Sworn to and subscribed before me this 10th day of April 1924.
W. Wilson Brown, Westchester Co., N. Y. Co. Clk's 844-Reg. 6620.
(Seal) My Commission expires March 30, 1926.

$25.00 in Prizes
See top of page 8 in front of book for full details

Building a Turret Attachment for a Small Lathe

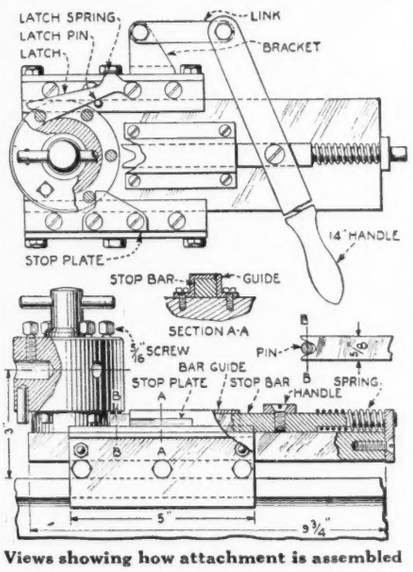
By Joe V. Romig

This is the last mechanical design of importance made by Joe V. Romig for POPULAR SCIENCE MONTHLY. *It was completed shortly before his death and forwarded to the Editor through the courtesy of Mrs. Romig.*

WHEN a small bench lathe is used for light manufacturing, a turret is almost invariably necessary. With an automatically operating turret and six tools in position, the work time can be cut to a minimum and duplicate parts quickly and accurately machined.

Turret attachments for small lathes, however, are expensive. If the lathe owner desires, he can save much of the expense by building his own. The design illustrated makes possible the construction of an accurate and long wearing turret. Standard cold rolled steel shapes are used, eliminating much of the otherwise costly machine work.

By using a lever feed in connection with the automatic turret, the turret is shifted with a minimum of effort and in the shortest time. Shifting mechanisms usually are complicated, but the one in this design is both simple and effective.



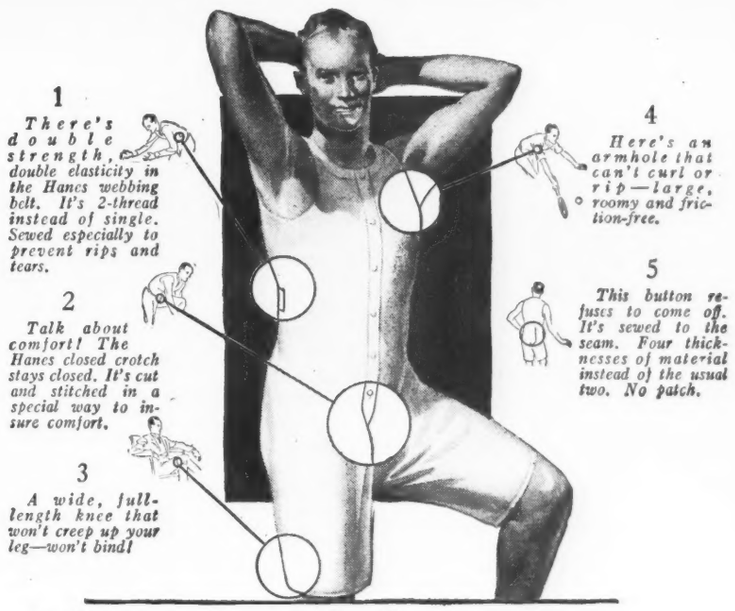
Views showing how attachment is assembled

While the dimensions given in the accompanying details are for a 6-in. attachment, the sizes may be altered in correct proportion for a lathe of any size.

Assuming that the lathe to be fitted has a flat shear, the builder works up the turret base, using a piece of ½ by 4 by 5 in. stock, to which he attaches the side angle plates shown. These plates reach up above the base, so as to allow the employment of the adjusting screws, which aline the side guides, operating on the turret side. The plates are shaped on their inner surfaces and should be straight and true. They are held to the base with three cap screws on each side.

The guide members are of ¾ by ½ in. stock, 5 in. long. The top plates are 3/16 by 13/16 in. stock, 5 in. long, and the assembly is made with four ¼-in. flat head screws on each side. The holes

(*Continued on page 100*)


1
There's double strength, double elasticity in the Hanes webbing belt. It's 2-thread instead of single. Sewed especially to prevent rips and tears.
2
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Building a Turret Attachment for a Small Lathe

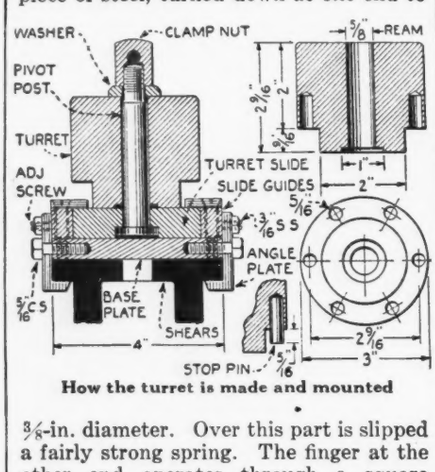
(*Continued from page 99*)

drilled in the side guides for the passage of the screws are made large enough to allow adjustments.

The turret slide is made from a piece of cold rolled steel ¾ by 3 by 9¾ in. This should be checked carefully for straightness and parallelism, using a straight edge and micrometer. A hole for the pivot stem is drilled and counterbored, as shown, and toward the rear end is later fitted the bearing plate of the indexing slide.

The turret proper, 3-in. diameter, is turned as indicated. The central hole is reamed to fit nicely over the pivot stem. A clamp handle and washer hold it tightly to the slide, when necessary. Equally spaced holes are drilled and reamed for the six 5/16-in. indexing pins, which must be a snug driving fit. These pins are made of high grade steel, hardened and drawn to a brown color.

The indexing finger is made from a flat piece of steel, turned down at one end to



How the turret is made and mounted

⅜-in. diameter. Over this part is slipped a fairly strong spring. The finger at the other end operates through a square guide, the fit being snug though free. The forked end of the finger is flared to make the entrance of the pin an easy matter, and case-hardened to prevent wear. A flat steel handle, 14 in. long, is attached to the indexing finger and connected with a link to a small bracket at the rear of the slide.

The shifting mechanism is extremely simple. A latch made as detailed is fastened to the top of the base by one of the four rear screws. This latch is pressed in toward the slide by a flat leaf spring, held under the central cap screw, the spring operating on the hump of the latch. A stop pin limits the inward travel of the latch and holds it in the proper position to receive an indexing pin on the rearward movement of the slide.

The action of the shifting device is as follows: When the slide is moved backward, the latch engages with a pin, as shown, and stops the travel of the slide. Continued pressure and movement of the handle compresses the spring and withdraws the indexing finger, at which the turret slide again moves backward, revolving the turret, until the stop on the front side engages another index pin. All rearward motion of the slide then stops. A forward motion of the handle causes

(*Continued on page 101*)

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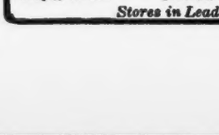

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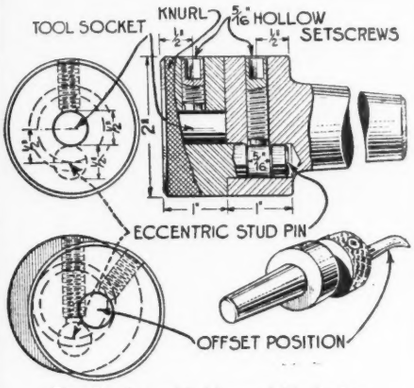
How to Make an Adjustable Boring-Tool Holder

IN BORING holes in jigs and accurate experimental models, the ⅝ to 2 in. adjustable boring-tool shown will do excellent work. It may be used in a drilling, boring, or milling machine.

This tool consists of two main parts made of machine or tool steel. Tool steel will be more satisfactory, but pack-hardened machine steel will serve the purpose.

To make the shank part, a piece 2⅛ or 2¼ in. in diameter is turned as shown



Details of a tool-holder useful in boring holes in jigs or other accurate work

and an eccentric hole is located, drilled, and reamed to receive the eccentric stud on the other part. It is then drilled and tapped for a setscrew. The taper shank is made to correspond with tapers used in the shop.

The tool-holding part is chucked off center enough to allow the eccentric stud and face to be turned. This stud should be a nice running fit in the corresponding hole. A recess 5/16 in. long by 7/16 in. in diameter is turned on it so that it will not be bruised by the pressure of the setscrew.

The first part is inserted in the lathe spindle and the second, after being placed in position and locked with the setscrew, is turned and bored for the central tool hole. It is also drilled and tapped for the tool-holding setscrew.

Hollow head setscrews are recommended, although square heads may be used.—H. L. W.

Building a Turret Attachment

(*Continued from page 100*)

the indexing finger to engage its proper pin and locks the turret in its new position.

After the turret is assembled, the last operation is to bore the ½-in. tool holes. A center drill is chucked in the head spindle, and the turret is revolved in its six positions. The holes then are drilled 1/32 in. under size, and are bored and reamed to the exact size. If the index pins are not exactly spaced, each pin nevertheless will aline accurately its corresponding hole.

The tools are held by setscrews, which should engage with a flat on each tool. Each flat should be equal to one quarter the diameter of the tool shank.

The travel of this turret, which is 4½ in., is ample for any operation on a lathe of 6-in. swing.

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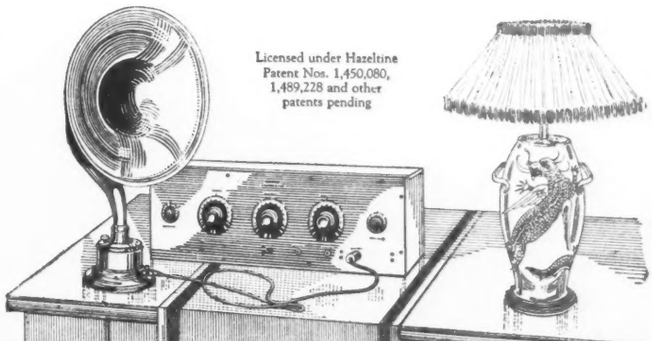

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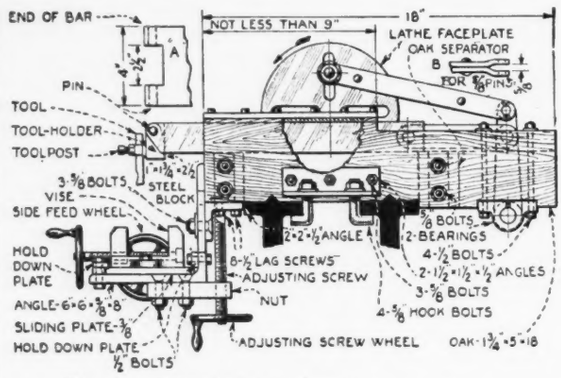
Building a Shaper for the Home Shop

By Frank N. Coakley

THE useful little shaper illustrated is a machine that most amateur machinists would like to own. And, unlike many handy machines they could make and would make but for the expense, it may be built with materials that are easily obtainable at a reasonable price. Expensive patterns, so often the stumbling-block of the home mechanic, are not needed.

Since the majority of home machinists own lathes, the lathe is utilized to provide the power for running the shaper. This is done by transmitting the motion to the sliding bar through a connecting rod from the lathe faceplate.



Side view of the shaper attachment, which is driven by a lathe faceplate

The connecting rod is made from two pieces of 5/8 by 2¼ in. flat brass, riveted together and forked at one end (see detail *B*) to fit over the outside lever. This lever may be purchased from any manufacturer of drop forgings, but those who are on a friendly footing with the village blacksmith possibly can get him to hammer out both levers, just to keep in trim.

The sliding bar is 1½ by 4 in. flat steel about 14½ in. long. The front end is made as indicated at *A* to take the toolholder, which, while a snug fit, must be not so tight that it cannot rise on the return stroke.

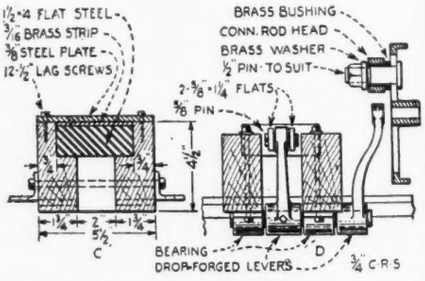
The side members, made of 1¾ by 5 by 18 in. oak, are grooved or rabbeted on their inner faces to provide sliding ways for the bar, and also shaped as shown in the side view. Angles 1½ by 1½ by ½ in. are bolted to each side of the assembled side members to take the hook bolts that hold the attachment down on the lathe. The width of the angles is governed by the width of the lathe bed. The side members and the two oak separating pieces are dovetailed together and held by four 5/8-in. bolts pulled up as tight as possible.

A short length of ¾-in. cold rolled steel in two standard ¾-in. bearings serves as a pivot for the levers, as in detail *D*. The sliding bar is held down by a 3/8- or 5/8-in. steel plate fastened with 12 ½-in. lagscrews. A 3/16-in. brass strip (see *C*) is fastened to the under side of this plate with small countersunk stove bolts, or, better still, copper rivets, to prevent any chance of steel rubbing on steel.

The rear end of the sliding bar is cut back the same as the front end and 5/8-in. holes are drilled to hold the pin for the two flats that act as a connecting rod between the short lever and the sliding bar. A 1 by 1¾ by 2½ in. steel block is drilled, tapped and filed to act as a toolholder. The toolpost is the same as ordinarily used on lathe or shaper.

The adjustable work bed is made up of standard material. The main support is a 2 by 2 by ½ in. angle about 6 in. long, securely fastened to the wooden members with 8 ½-in. lagscrews. The vertical leg has 3 5/8-in. countersunk holes drilled in it to provide fastenings for the up-and-down feed base. This base is made from a 6 by 6 by 5/8 in. angle about 8 in. long and is provided with 3 slotted holes to allow for the up-and-down adjustment and also to hold it in place against the 2 by 2 in. angle. This arrangement allows the use of a sliding plate to which is fastened a standard vise of the type illustrated.

The vertical adjustment is obtained through a ¾-in. screw; the horizontal movement is regulated by a screw fastened to one end of the sliding plate. The handwheel may be obtained from a junk dealer and the handle tapped into the rim or left off, at the option of the builder.



Details showing wooden ways, sliding bar, top plate and arrangement of cranks

The pin used to drive the sliding bar from the lathe faceplate can be made from a piece of cold rolled steel. The head should be at least 1 in. larger in diameter than the pin proper. This is pulled against the rear side of the faceplate. The body of the pin is of proper size to pass through the faceplate slot. A brass bushing is made to slide over the body of the pin; it should have a flange large enough to prevent the connecting rod from rubbing against the faceplate. The body of the pin being somewhat shorter (say 1/8 in.) than the bushing, allows the pin to be clamped up tightly to the faceplate. A brass washer is placed between the nut and the bushing; this prevents the connecting rod from rubbing against material of its own kind. It will be well to go over all surfaces that rub or fit against other surfaces with a file to finish them smoothly.

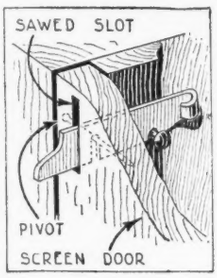
Before assembling the machine, soak

(*Continued on page 103*)

Removable Screen Door Latch

IT IS often desirable that a screen door should be locked against small children and yet provide free entrance and exit for older folk. The latch illustrated does this.

The main member is formed of a thin and fairly wide metal strip, bent as shown to suit the thickness of the screen-door frame. Cut a slot through the frame just inside the stop against which it strikes and quite high. Use a small drill bit to start the slot and work it to the required length with a keyhole saw. Drive a nail into the edge of the frame to act as a pivot pin.

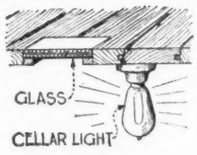


Latch is above reach of the children

Have the latch so balanced that the weight of the hook end will cause it to engage quickly the latch post on the main door frame. This post may be a short, round-headed screw, turned well in. The latch may be removed by lifting it straight up and over the pivot pin.—L. S.

Telltale for Basement Light

HOW often have you forgotten to turn out the light in the cellar? A simple and yet certain reminder can be made by cutting a small hole in the kitchen floor under the sink or in any convenient, out-of-the-way place and inserting a piece of thick glass.—O. M. A.



Building a Shaper

(*Continued from page 102*)

the oak well with oil along the surface on which the sliding bar rubs. When this is once done, it will not be necessary to oil the surface for a long time. A grease cup is placed on the top holding-down plate to provide lubrication between the brass strip and the sliding bar. The two levers, which are keyed snugly to the ¾-in. shaft, and the two ¾-in. bearings can be lubricated with grease cups on the under side of the bearings, or through oil holes drilled at an angle through what will be the upper side of bearing. Keep all moving parts well oiled and tight.

A machine like this should last for years with proper handling. While I have given no dimensions for the lathe-bed and the fastenings, it will be understood that these will be governed by the size of the lathe. This also limits the stroke, although on an 8 or 9 in. lathe the stroke should be 4 or 5 in.

Some one may ask: "Has this machine a quick return stroke?" No, it has not; why should it? This feature would complicate the design and, as amateurs are not working under a boss who wants as many pieces of work done as possible, we can dispense with the quick return feature.

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Log Used as Light Roller for Lawn and Garden

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Making Cheap Window-Screens Give Long Service

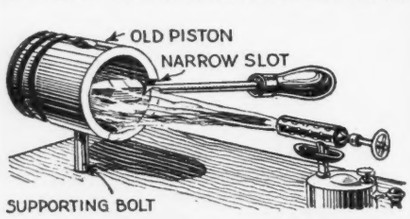
ON OCCUPYING a new house, the question of window-screening arose. After careful comparison of cost and lasting qualities, it was decided that full-length screens would be best. Wooden frames were made of 1 by 2 in. pine, mitered at the corners, screwed together, and painted white.

Galvanized screening was used. It was painted black as soon as it was fastened to the frames. Our home being near the seacoast, the salt air soon would have rusted out ordinary black screening. Bronze, although desirable, was barred on account of cost.

The screens are now three years old, and in excellent condition. A yearly application of black screen enamel is made where the galvanized wire, by showing the color through, betrays the wearing of the old coat. This, indeed, is the secret of our method. Black wire, when wearing, gives no indication, as the metal rusts and turns black as soon as the enamel is off, and galvanized wire does not show deterioration until the rusting has actually started, when it is sometimes too late, but the combination of enamel on galvanized wire is good.—R. C. TARR.

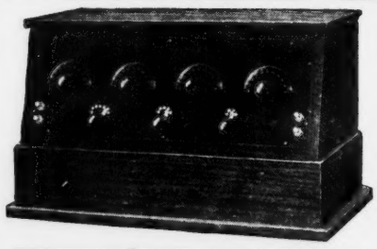
Old Piston Useful in Heating Soldering Iron Rapidly

WHEN a soldering copper is held over the open flame of a blowtorch, a great deal of the heat is wasted. A faster and more economical method is to use an old auto piston to conserve the heat, as illustrated.



Piston prevents waste of heat from blowtorch

Saw a small slot diagonally through the skirt of the piston so that it will take the shank of the soldering iron. Then mount the piston horizontally at one end of the workbench by fastening a bolt through one of the wristpin bearings.—L. B. R.



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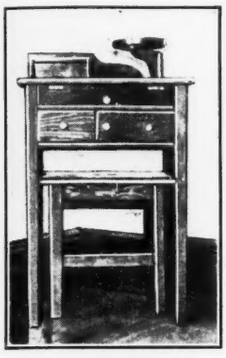
Blueprint Will Help You Build Neat Telephone Table

COULD you use a telephone table and stool in your home? Then why not build it yourself with the aid of POPULAR SCIENCE MONTHLY'S Home Workshop Blueprint No. 18? Louis Bergstrom, of DuBois, Pa., used that blueprint in constructing the table and stool illustrated. He writes:



Made by Louis Bergstrom, of DuBois, Pa.

I used fir, stained a dark oak. The grain of this wood shows up very beautifully in this colored stain. Every one who has seen it says that it makes a most attractive piece of furniture.

The table top is 17 by 21 in., large enough to be used, when necessary, as a writing table. Besides the swinging telephone stand, there are racks for stationery. Beneath the top is a compartment for the telephone directory and drawers for index cards and writing materials.

If you wish the complete working details and bill of materials, use the coupon below to order Blueprint No. 18.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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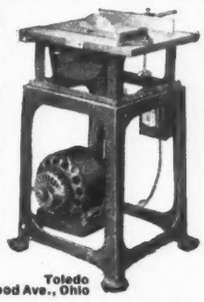

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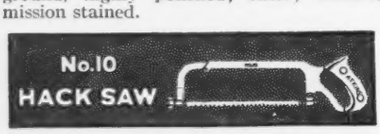
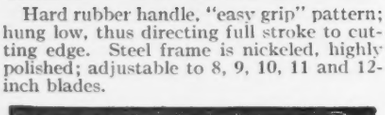
SILVER STEEL blade, taper ground, given Atkins exclusive Damaskeen Polish. Improved Perfection Handle, which eliminates wrist strain. Cuts fast and easy. Regular or Ship Point Pattern.

A new saw for the Boy Scout and radio mechanic. Handy for home use, too. Made 20 in. long, skew back, nine points, taper ground, highly polished; cherry handle, mission stained.



Hard rubber handle, "easy grip" pattern; hung low, thus directing full stroke to cutting edge. Steel frame is nickeled, highly polished; adjustable to 8, 9, 10, 11 and 12-inch blades.



This set includes 12-inch keyhole blade, 14-inch compass blade and 18-inch special nail-cutting blade, interchangeable in adjustable handle.

"Saw Sense" shows Atkins wood-cutting saws, tells how to file saws and gives helpful facts on building. "Saws in the Shop" shows our metal-cutting saws, and contains many money-saving suggestions. To get the booklet you want, write your name and address on this page and mail to us.

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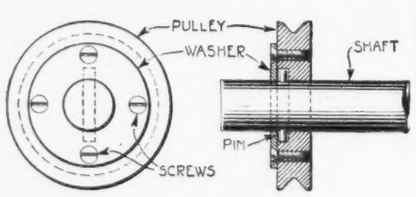
Pin and Washer Fasten Small Pulleys Firmly to Shaft

By Howard Greene

AFTER a good deal of experience, satisfactory and otherwise, the writer has adopted the method here described for keying small pulleys on their shafts. It is easy and mechanically good; it holds the pulley well and has the further advantage that when used for keying a pulley made of thin material without a hub, it keeps it stiff and true on the shaft.

The key is a simple round pin passing diametrically through the shaft, its size depending, of course, on the size of the shaft. Mark the location of the pulley on the shaft, and locate the hole so that it will just be covered by the pulley, the edge of the hole and the face of the pulley coming on the same line. Cut a groove in the face or hub of the pulley deep enough so that the pin or key will lie snugly in it, but projecting the merest trifle above the surface. Get a washer, or make one, with the hole the same diameter, approximately, as the shaft and drill it, and drill and tap the pulley for four countersunk screws. This completes the construction work.

To assemble, put the pulley on the shaft, slip the pin into the hole, bring up the pulley so that the pin goes into the groove, and screw the washer in place.



Simple method for keying small pulleys that is particularly useful for the amateur mechanic

The washer pinches the pin to the pulley and holds it securely, and if the pin is a good fit in the hole, the key will never give any trouble.

Where the pulley is of such thin material that it will not hold true on the shaft without additional support, the pin provides just what is needed. In such a case, however, particular pains must be taken to have the hole for the pin exactly at right angles to the shaft and to have the groove for the pin of equal depth from end to end. Otherwise the pulley will run out of true. Even then, however, matters can be mended by letting the pin a little deeper into the groove at one end than at the other.

If the pulley is exceptionally thin, it can be supported still further by using two pins, one on each side of the pulley and at right angles to each other. Only one need be held by a washer, but the second pin must be snug and tight.

One of the advantages of this arrangement is that it is much easier to remove a pulley than if a pin is passed through hub and shaft. Simply remove the screws from the washer, push back the pulley and pull or tap out the pin. Obviously, gears can be mounted in the same way, although in mounting gears it should be remembered that a slight wabble that would not affect the work of a pulley would make a gear noisy and inefficient and cause it to wear unevenly.

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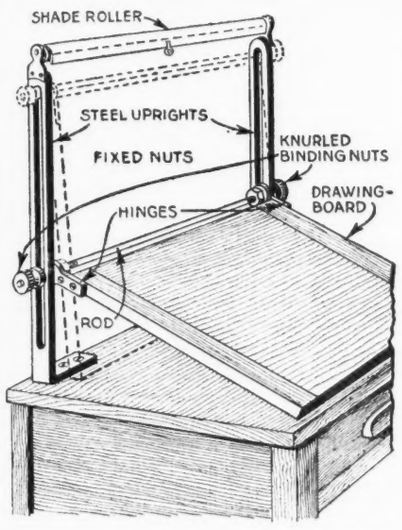
EQUITABLE MUSIC CORPORATION
1658 Broadway, New York City

Adjustable Drawing Board Mount for Desk or Table

FOR mounting a small drafting board on the desk or table of the home draftsman, the method illustrated has many advantages. The board can be adjusted to any desired angle and when not in use can be swung against the wall out of the way, so that the desk can be used for other purposes. Another feature is the shade roller for protecting the drawing from dust and preventing it from fading or blurring when temporarily laid aside.

Two slotted uprights of 1¼ in. by ¼ in. cold rolled steel are attached with wood screws to the surface of the desk near the rear edge. If the desk or table upon which the board is installed is placed against the wall, the uprights will not be obstructive. To the top of these uprights are riveted the brackets that hold the shade roller.



When not in use, this board stands at the back of the table

Attached to both sides of the drawing board are hinge pieces each having a ⅜-in. hole by which the board is attached to the cold-rolled rod that protrudes from the uprights. A check nut and a knurled binding nut are provided at each end of this rod.—C. M. WILCOX, Torrington, Conn.

Filing Small Lathe Tools

CUTTING tools for small lathes made from ¼ or 5/16 in. steel are sometimes unsatisfactory because the faces and edges are slightly rounded in grinding. This interferes seriously with good work.

An excellent way to make such tools is to file them up from soft steel (annealed tool steel), using small, fine-cut files for finishing. Then bring them to a smooth finish on the oilstone. Harden and temper them in the usual way, and finally clean them up with a little rub on the oilstone.

It will be found that it is easier to keep the edges correct in this way than by finishing after hardening, and it is also less trouble, because it is easier to work the steel before hardening. Also, the best part of the steel is the surface skin, which grinding removes.

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What using C.V. Steel in wrenches means to you. Up to now, Chrome-Vanadium Steel has been used for automobile springs, and similar products where an especially fine quality steel is needed.

Now, you can have wrenches made of this wonderful steel.

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We are so sure that you will find these wrenches the finest and most beautiful tools you have ever seen, that we are making this Special Offer.

Send $5.00 (add 85 cents if you want the sturdy leatherette roll) and we will send you the kit illustrated, containing 6 C.V. wrenches with 12 different size openings. If, at the end of ten days you are not thoroughly satisfied return the wrenches and we will promptly refund your money. This is our guarantee. Our dealers make this same guarantee.

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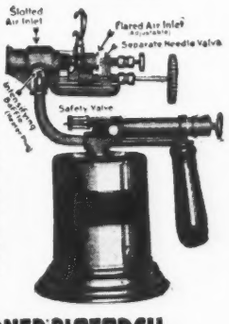

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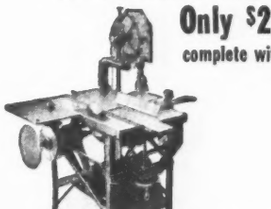

8 inch Circular rip saw
8 inch Circular cross cut saw
11 inch Band saw
4 inch Jointer Shaper
10 inch sander
lathe—14 inch swing

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If the old car seems a bit dingy, then get busy. Just a couple of hours of your time, a small amount of Lowe Brothers Automobile Varnish Color and you'll think twice before you trade-in your car.

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Then there's the porch furniture. After being stored away all winter it deserves a fresh coat of paint. A coat of Lowe Brothers Automobile Varnish Color will effect a magical transformation in its appearance and provide a finish that will retain its freshness for several years.

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Maybe the linoleum in the kitchen is showing signs of hard usage. If such is the case Neptunite Floor Varnish will brighten up its faded colors and give it a new lease on life.

Everything

And there's the flower boxes, the screens, the front porch, in fact, lots of small jobs that you can do. For whatever painting you may have in mind there is a Lowe Brothers Product specifically made for that work.

Go to the Lowe Brothers Dealer in your town. Tell him what you're going to do. He'll make a lot of valuable suggestions and will supply you with a paint, varnish, enamel or stain noted for its beauty, durability and economy.

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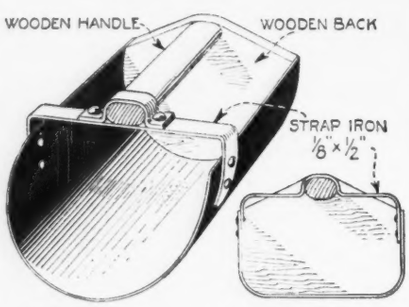
PAINTS & VARNISHES

Large Homemade Grain Scoop Has Handle on Top

CHEAP as grain scoops are, farmers will find it pays to make their own scoops of the type illustrated. A large scoop with the handle at the end, as customary, is unhandy and cannot be used conveniently in cramped places, but one with a handle over the center saves effort.

Scoops can be either half round in section or square, for use in bins with square corners. Medium gage galvanized sheet iron is cut to the shape desired and drilled



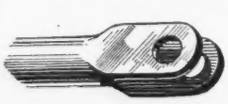
Half-round and square-bottom grain scoops, showing two methods of fastening the handle

for the small nails that hold it to the back board. Oval handles, of straight grained wood, are fastened by a single screw to the rear board and held in front by a ¼ by ½ in. flat iron brace. Two methods of making the brace are shown. The grip can be improved by wrapping the handle with stout twine from end to end.

Making a Forked Rod End from Plain Tubing

THE forked rod end illustrated makes a good job for small, light work. Either brass or steel tubing may be used, although it is not always easy to obtain small tubing in steel.

The first step is to flatten the end for a length a little more than the length of fork required. This may be done neatly by inserting a solid rod in the tube up to the point where the flattening is to begin and keeping it there while flattening.

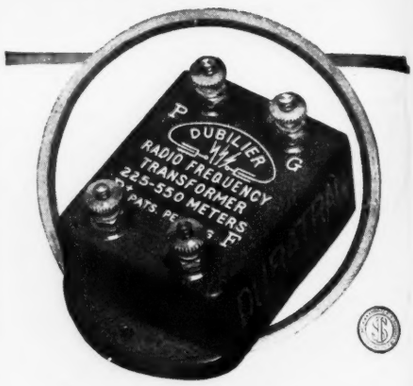


A simple rod end for light work

File away the edges of the flattened portion until the wall is cut through. A piece of flat steel can then be inserted between the separated jaws and a light hammer used to finish the flattening and provide the proper amount of separation. It remains only to trim to shape, clean up, and drill for the pin.

Unless the tubing is heavy, the bearing surface will be small, but to some extent this can be compensated for by the use of a large pin. A rod to connect with this can be made in a similar way, except that the flattening is carried further to make a fit between the jaws. A variation can be made by partly flattening the whole rod.—H. G.

TO BEND copper tubing for gasoline lines without its kinking or cracking, fill the pipe with melted resin and allow it to cool.



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Don't throw your one-tube regenerative receiver away because you can't get the distant stations. These free blueprints will show you how to add a stage of Duratran radio-frequency amplification and bring in all the stations within range no matter what the wave-length may be.

You save the ten or fifteen dollars you would spend for new parts if you follow the free Duratran blueprints.

The Duratran amplifies uniformly twenty times on all broadcasting wave-lengths and with all standard tubes.

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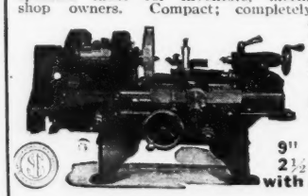

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RADIO HEAD SET

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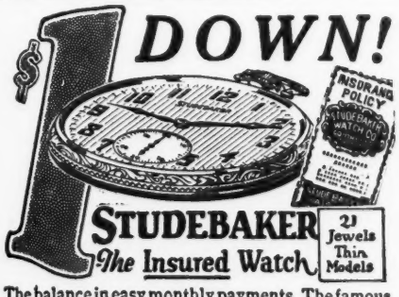

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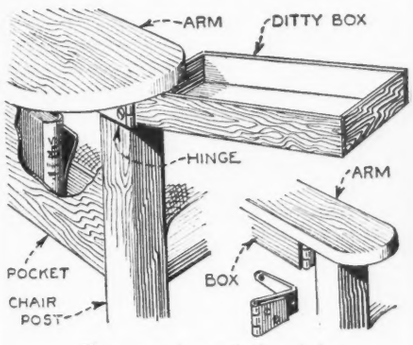
Swinging Tray and Pocket Add to Armchair's Utility

SOMETIMES we must hunch into that old armchair and concentrate on some problem with the aid of books, paper, pencils, ink, drawing tools—inspired by peppermints or a dried-up plug.

Such a chair should have a wide arm, with a ditty-box hinged underneath, as



How a tray is attached to chairs with either wide or narrow arms

illustrated. The writer has a cigar-box about 1¼ in. deep, swung on the flap of a 5-in. strap hinge. There is a suitable hinge for any size and shape box desired. A loose-pin butt will permit the removal of the box if its contents are required at the bench.

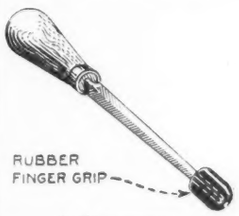
Between the side posts you can make room for a paper or book pocket, built with thin board stock. Let the bottom be 3 or 4 in. below the seat, and the inner side open about level with the seat. Case the outer side to the arm.

A box can also be fitted under the narrow arm of a "best-room" chair, as indicated in the smaller drawing. This arrangement will interest a woman, for the box is a handy place for sewing accessories, writing materials, and odds and ends that nobody likes to leave a comfortable seat to fetch.

A table without a drawer may be fitted with one or more of these boxes, for the larger strap hinges will support considerable weight.—ROLAND B. CUTLER.

Baby Carriage Tire Forms Finger Grip for File End

ANY one who has much saw filing to do knows how sore the fingers of the left hand become. I have tried wrapping the end of the file with tape, as well as using a cork and block of wood, but the best protector so far discovered is a piece of baby-cab tire.



A file accessory that costs little

It will not creep off the end; it can be changed instantly from one file to another and it forms a firm soft grip for the fingers. In making it, I find that a piece 1 in. long, rounded on one end, is the most satisfactory. This can be obtained, sometimes merely for the asking, in almost any furniture or bicycle shop.—S. A. MCLEAN, Denver, Colo.

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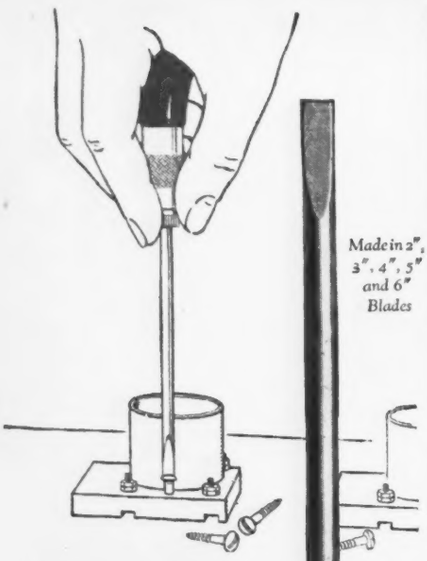

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When the screw is started, you can use No. 55 with a right or left ratchet movement—or lock the ratchet and you have a plain screw driver. Choice of blades 2 to 6 inches.

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When you buy your next screw driver, pay a little more and get a *ratchet* screw driver with the Millers Falls trademark. There's a world of difference.

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MILLERS FALLS TOOLS SINCE 1868

The Shipshape Home

"How I Keep My Home Shipshape"

Three Prize-Winners in POPULAR SCIENCE MONTHLY'S Recent Interesting Competition Offer Many Practical Ideas

By Ruth Darling Shultis
Albion, Michigan
First Prize, $25

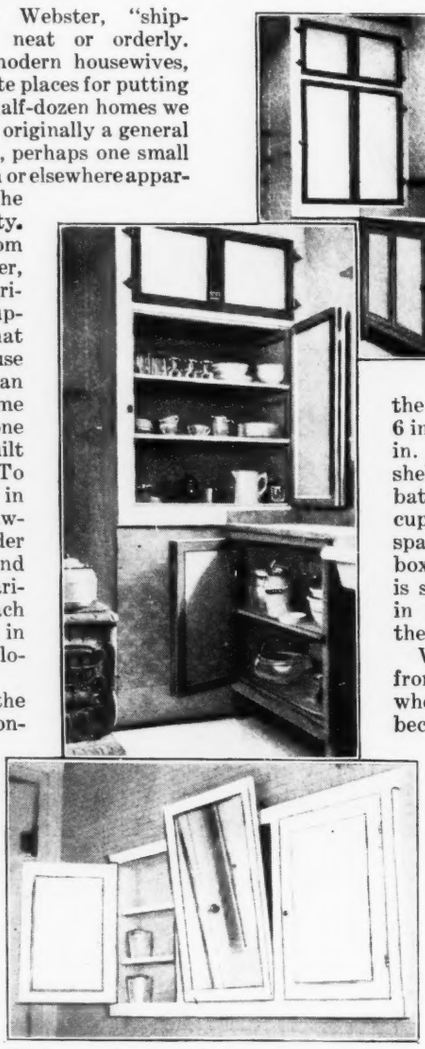
ACCORDING to Webster, "shipshape" means neat or orderly. According to modern housewives, "order" means adequate places for putting things away. In the half-dozen homes we have owned, there was originally a general lack of cupboard room, perhaps one small cupboard in the kitchen or elsewhere apparently having satisfied the builder's idea of necessity.

We have gone from one home to another, through the years, veritably building in cupboards! So we feel that we always left a house more "shipshape" than we found it! Our home here in Albion had one kitchen cupboard, built in the wrong place. To date, we have built in this house two big drawers (in waste space under a stair landing), and seven cupboards of various design and size, each for a definite use and in the most convenient location.

These cupboards in the walls not only afford convenience in storing articles, but contribute to the neatness of the home.

In the kitchen we built one deep dish-cupboard into the unused headroom over the cellar stairs. Opposite to this we built another, running from floor to ceiling. Between these two cupboards are the sink and drainboards, beneath which are two more cupboards for kitchen utensils. The backs and door panels of these cupboards are made of beaver board, the rest of the material used being heavy enough to be very substantial. The finish is white enamel or stain, to correspond with the room finish.

In the bathroom we have built in three cupboards, actually built them "in," as the two beside the mirror, for toilet articles, whose doors close flush with the wall, are 4 in. deep and completely utilize the wall depth. They are built of hard pine and beaverboard, like the others, with doors opening away from the mirror and so constructed that mirrors may be set on the inner sides. The third bathroom cupboard is deeper, being set, like the others, 4 in. in the wall, but projecting 6 in.; it is 35 in. high, 20 in. wide, with four 9-in. shelves for towels and bathroom supplies. This cupboard is set in the space above the toilet box, and a glimpse of it is shown by a reflection in the mirror shown in the lower illustration.



Kitchen cupboards with doors open and closed, and double medicine cabinets in bathroom

We are never deterred from placing cupboards where we wish them because of the doors' swinging in the way. We plan the doors as carefully as the cupboards themselves, for an awkward swinging door often spoils the convenience of the cupboard. The accompanying illustrations show not only the cupboards, but our method of folding the doors by hinging one onto another and swinging them back against a small wall space.

Honorable Mention

Harry C. Mosher, Dowagiac, Mich.
J. S. Hagen, Des Moines, Ia.
C. P. Andrew, Charlotte, N. C.
S. A. Fraser, Middletown, Ohio.

"How I Keep My Home Shipshape"

By Alice G. Whitman
Canso, Nova Scotia

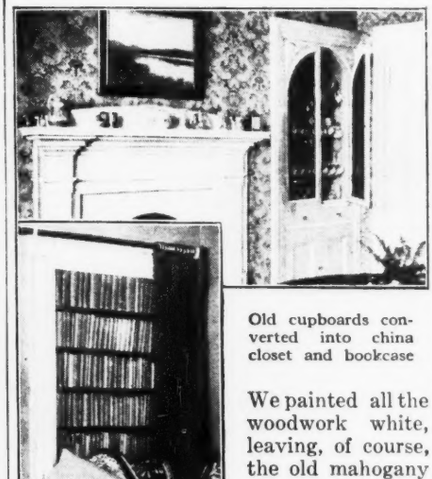
Second Prize, $15

WHEN Edward and I were married, we came to live in a small fishing-town on the seacoast, in the old homestead in which his father and grandfather had lived before him.

It was a house of many possibilities—a low, rambling place, with a door in the center and rooms on each side, and an open fireplace in every room.

When we came into possession of the house, it was painted a dingy brown with darker and dingier brown trimmings. Inside the woodwork was of the same dingy hue. First of all, we had the house reshingled and the shingles stained with a creosote stain, all the trimmings painted white, and the roof a moss green.

We then turned our attention to the inside, and white paint worked wonders.



Old cupboards converted into china closet and bookcase

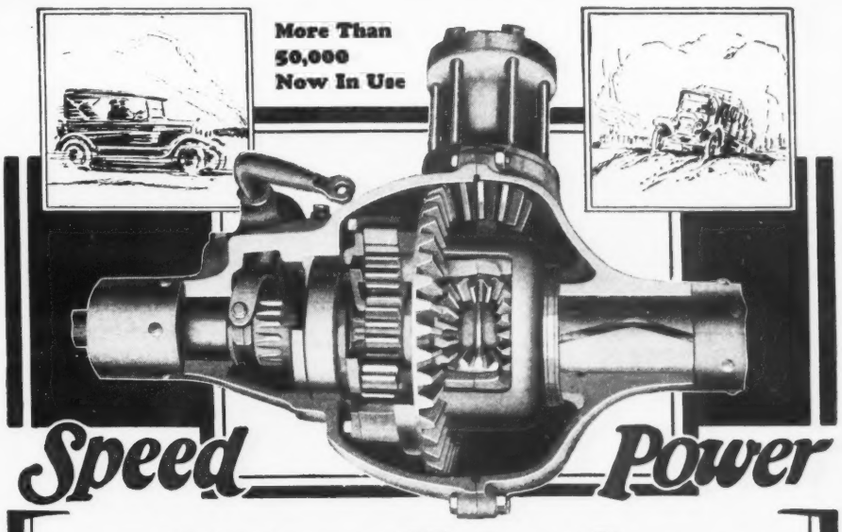
We painted all the woodwork white, leaving, of course, the old mahogany balustrade and stair treads.

Needless to say, the old wallpapers were unattractive and the house had to be repapered. In the dining-room we put a blue tapestry paper; in the drawing-room a plain yellow oatmeal paper. and in the library a soft gray. The kitchen walls, above the wainscoting, we covered with a plain yellow table oilcloth. It is a durable wall-covering, easily cleaned with soap and water.

Before we papered and furnished the rooms, we turned our attention to some of the 27 pantries or closets the house contained.

We are delighted with the transformation of a cupboard in the dining-room—the one beside the fireplace. We had the door removed, extra shelves put in, then a leaded-glass door and a drawer and closet provided underneath. This closet is one of the most convenient things in the saving of time and labor. Here I keep my best china; in the drawer, tablecloths, napkins, and doilies. In the cupboard below we have hard wood for the grate.

In the drawing-room two pantries were transformed—one into a bookcase for choice books, the other into a window-seat. In the library we had low bookcases made to go all around the room. These shelves are of pine stained walnut.



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The MIRACO is so popular because it is priced at a ridiculously low figure for a real quality set. Just think, only $29.50 for the model shown in the illustration above and users tell us that they have gotten as many as 122 stations in three consecutive nights and many of them over 2000 miles away. For instance, Mr. E. D. Elliott of Milford, New York, got London, England, Fairbanks, Alaska, La Palma, Panama, San Francisco, Los Angeles, Hood River, Oregon and many others within several evenings. Others have done equally as well.

Everyone can now own a Quality Radio Set

These two improved MIRACO models make it possible for every family to own a set—to have a box seat for the opera or symphony or jazz concert right in their own living room.

Workmanship is unexcelled—easy and simple to operate—always dependable. Solid mahogany cabinet—fully guaranteed against any defects in workmanship.

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DEALERS—AGENTS

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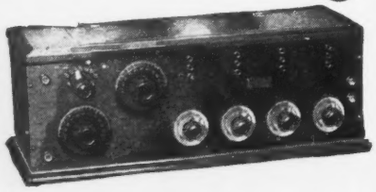


Midwest Radio Company
808 Main St. Cincinnati, Ohio

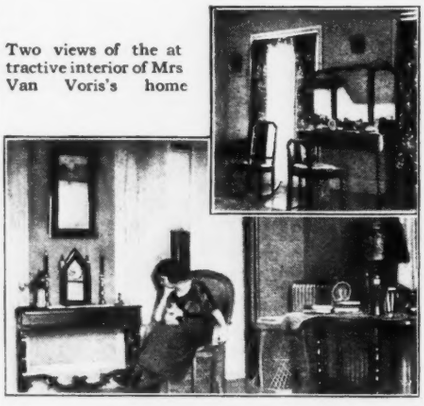
"How I Keep My Home Shipshape"

By Gladys B. Van Voris, Cobleskill, N. Y.

Third Prize, $10

VISUALIZE a mid-Victorian house, neither Colonial nor modern; its beauty depending entirely on its cleanliness, orderliness, and state of repair. The last—state of repair—is our problem, so we have tackled it ourselves with the help of one paperhanger.

When our house needs papering, we select a cheap paper, but are careful about color and design in order to use it without eyestrain and headache until actually soiled. It is soft tan or gray for living-room, plain or practically so; light gray or softly flowered designs for the bedrooms. Not caring to hang our pictures from molding, we finish our walls with ¾-in. quarter round—very inexpensive and giving an artistic finish when painted to match woodwork.



Two views of the attractive interior of Mrs Van Voris's home

I find old ivory flat paint excellent for woodwork and white enamel for kitchen and bathroom. I always keep glass jars of both paints and small paint brushes ready to touch up any spots where the paint has been knocked off. This treatment of woodwork has lasted 10 years without repainting—just washing with good soap and water and occasionally touching up.

Floor treatment is most important, and ours is so highly successful, many have asked us our method. Large boards and cracks needed crack filler first. Then we applied old-fashioned yellow floor paint. After two days of drying, we spread on smoothly a coat of light oak varnish. I wish you could see our lovely mellow floors!

Because we used good varnish, we have only renewed once, save on stairs, in bathroom, and on the kitchen linoleum, which we do about twice a year. We varnish every other tread of the stairs so as to have some to use, and do the kitchen and bathroom by halves.

Varnish and paint applied at the first sign of wear, homemade washers for faucets, our frequent porch painting and waxing, and our loving care of our handiwork, together with the use of mild soaps for our surface cleanings, are the most important means in keeping our home shipshape and reducing our repair bill to its minimum.

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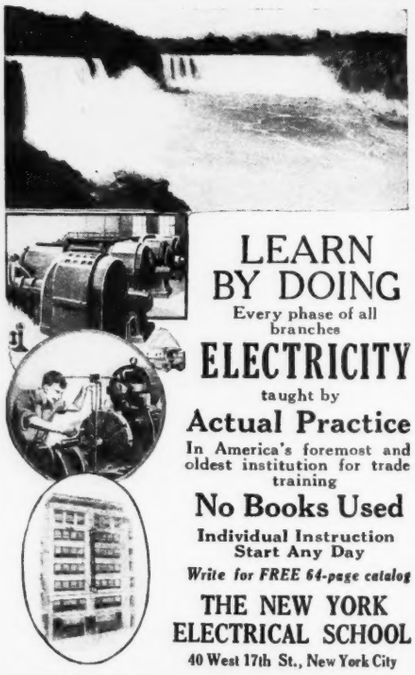

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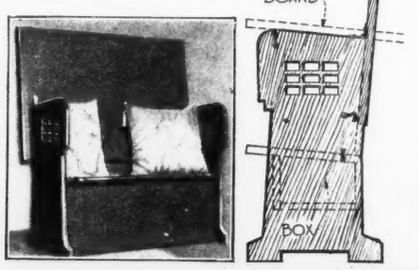
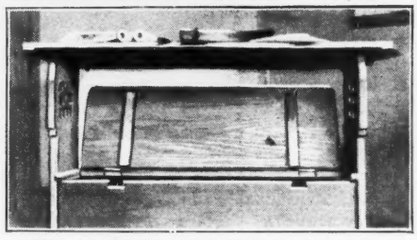
$1000 Cash says I can clear your skin of the above blemishes.
E. S. GIVENS, 153 Chemical Bldg., Kansas City, Mo.

Attractive Living-Room Bench Is also a Drafting-Table

THE problem of where to put a drafting-table and drawing-board is one that puzzles most home workers. I solved it by building the combination drawing-table and seat for the living-room illustrated below.

Under the hinged seat is a box where paper, architectural books, rolls of plans, drawing instruments, and the like can be kept. The back of the seat is hinged to the arms, and when tipped forward serves as a drawing-board. Small brass hooks hold it in either position.



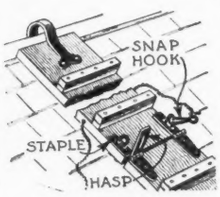


The combination bench and table in its dual rôle, and diagram showing construction

The ends of the seat are 1 or 1⅛ in. thick, and the end battens of the drawing-board are 1 by 1¾ in., rabbeted and fastened to the board with screws in such a way as to allow for any shrinkage. The remainder of the stock is ¾ in. thick.—A. L. DORR, S. Pasadena, Calif.

Extension Ladder for Roof Work Has Safety Fastenings

WHEN a ladder for roof work is to be extended over its usual length of about 14 ft., I fasten the extension to it with ordinary hasps and staples, as illustrated. Harness snaphooks are used to prevent the hasps accidentally becoming undone.



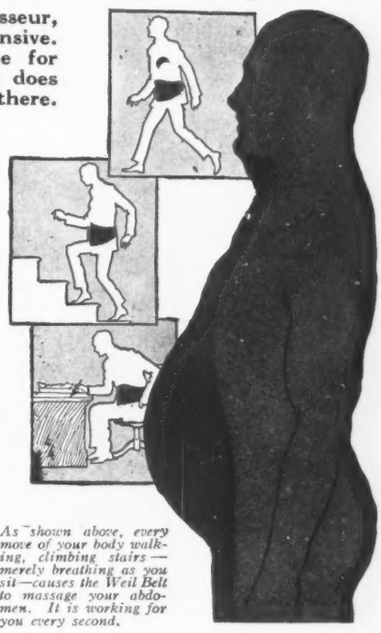
Extension is held by hasps and staples

The ridge hook is homemade and bolted securely to the upper end of the extension, which is a light, solid cypress or pine board. The steps or foothold pieces are in two thicknesses, held with nails driven through and solidly clinched.

I have used this device hundreds of times and find it perfectly satisfactory. It avoids the risk of accident with the makeshift nailed extensions so often used, and also saves having to carry several sizes of ladders in my storeroom. — CHARLES W. HUBERTZ, Corry, Pa.

New Self-Massaging Belt Reduces Waist—*Easily!*

Produces same result as an expert masseur, but far quicker, easier and less expensive. Substitutes good, solid, normal tissue for that bulky, useless disfiguring fat, yet does it so gently that you hardly know it is there.



As shown above, every move of your body walking, climbing stairs — merely breathing as you sit—causes the Weil Belt to massage your abdomen. It is working for you every second.

Science has found a delightfully new way to quickly remove fat and obtain a normal waistline—without straining your heart with violent gymnastics or weakening your system by starving.

Formerly those who wished to reduce without dieting or strenuous exercise had to go to a professional masseur. His method effectively dislodged the fat and brought about the desired reduction. But it was expensive and time-consuming, and so few could take advantage of it.

Remarkable New Invention

But now a wonderful new invention brings this same effective method within the reach of all. The Weil Scientific Reducing Belt uses this same massage principle, acting by means of its specially prepared and scientifically fitted rubber. It is so constructed that as you wear it, every breath you take and every movement you make imparts a constant gentle massage to every inch of the abdomen. Working for you this way every second, day and night, it reduces much more rapidly than ordinary massage, saving both time and money.

Actually Removes Fat

It does not merely draw in your waist and make you appear thinner. It actually takes off the fat. Within a few weeks you find 4 to 6 inches gone from your waistline. At the same time all your stomach disorders, constipation, backaches and shortness of breath disappear as the sagging internal organs are put back in normal place. Man or woman, you are filled with a wonderful new energy, and both look and feel 10 to 15 years younger.

The Weil Belt is used by hundreds of professional athletes and jockeys because it not only reduces quickly but at the same time preserves their strength. Highly endorsed for its healthful principles by physicians everywhere. Satisfaction guaranteed or your money back without question.

Write today for full description. If you write at once you can also get in on a Special Reduced Price Offer being made for a limited time. Mail coupon today to **THE WEIL COMPANY, 106 Hill Street, New Haven, Conn.**

The Weil Company,
106 Hill Street, New Haven, Conn.

Gentlemen: Please send me, without obligation, complete description of the Weil Scientific Reducing Belt and also your Special to-day Reduced Price Offer.

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Henry Maust's work appears in Saturday Evening Post, Cosmopolitan, etc.

Francis Parks, following their advice, is now a cartoonist for the Omaha News.

Fred Neher is comic artist with the Universal Feature Co.

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Here's your opportunity to avoid high apartment rentals. Build this home yourself. Two men can build it in a week. Our instructions explain every step. Five plans shown in Aladdin catalog.

Large living room, kitchen, 3 bedrooms, large veranda—an ideal place for outdoor dining-room or sleeping quarters. Summer cottage price includes lumber cut-to-fit ready to nail in place, windows, doors, hardware, nails, roofing, paint, etc. Freight paid to your Station. Write today for Summer Cottage Booklet No. 1095.

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

YOUR tools and steel instruments are very susceptible to atmospheric moisture. They rust easily if they are not in constant use.

Smaller instruments can be cleaned readily from rust by placing them in a saturated solution of tin chlorid overnight; the reduction that takes place removes the rust. After taking up the instrument, you should wash it with water and place it in a hot solution of soap and water, to which a little sodium carbonate has been added. Dry the instrument, dip in alcohol (denatured) to remove last trace of moisture, and polish.

Making an anti-rust solution

Rusting is prevented quite easily if precision instruments, such as micrometers, after being freed from any rust spots, are placed in the following solution: A teaspoon of kerosene in a glass of benzene, to which a very small piece of paraffin, less than half the size of a pea, is added. When the solution has entered all crevices, remove it and place the instrument to one side so that the benzene may evaporate.

Metals such as gold, platinum, and silver are influenced to the least extent by the atmosphere; the lesser noble metals, such as iron, copper, lead and zinc, soon show signs of oxidation by the formation of oxids of these metals. The noble metals can be cleaned by rubbing their surface with soft leather, provided the tarnish is not due to sulphids. The sulphid tarnish of silver, if not too old and too deep, also can be cleaned in this way. If it is severe, use a mild abrasive, such as precipitated chalk. If the precipitated chalk is mixed with a little water and a little ammonia, a chemical action is set up as well as the abrasive action of the chalk, and this will clean the silver thoroughly and quickly.

Removing stains from polished brass

The difference between tarnish and corrosion of a metal is in the depth of the oxidation. When it is slight, it is tarnish; when deep, it is corrosion. The most common method of cleaning metals from tarnish is by the use of an abrasive, although chemical methods are sometimes to be preferred. The selection of the proper cleaning method depends upon the chemi-

(*Continued on page 115*)

Prizes for Photographs

IF YOU have made or are making any article with the aid of POPULAR SCIENCE MONTHLY'S blueprints, don't fail to make a photograph of your handiwork. Then send us a print. We are always glad to see such photographs, and for each one considered worthy of publication we shall pay $2. Address the Home Workshop Editor, Popular Science Monthly, 225 West 39th Street, New York.

Steamtight Kettle Cover

TO RETAIN the full flavor of meat and vegetables and to prevent odors and steam from escaping, steamtight covers can be made quite easily for the usual convex kettles and cooking utensils.

Flange is made from a cake tin

The cover consists of an ordinary cake tin with slightly tapered sides, soldered to the regular kettle cover. After this the bottom is cut off, leaving only a flexible tapered flange, which wedges into the kettle and fits closely, especially if a weight such as an old flatiron is placed on top. The only possible difficulty is to find a cake tin to fit the kettle, but I have found the device practical in my own household and am quite sure that it effects some saving in gas.—E. W. CORNELL, Adrian, Mich.

Home Workshop Chemistry

(*Continued from page 114*)

cal character of the metal to be cleaned.

Brass is a mixture of zinc and copper, and the tarnish produced is mainly the dark sulphid or oxid of copper. A quick and economical method of cleaning this metal is to wipe, and at the same time polish, with a mixture made by adding a little acetic acid to water and stirring in a teaspoon of salt. The odor of the solution is like that of vinegar. Wash the cleaned article with water and rub dry with a little precipitated chalk.

Copper can be cleaned in the same way, the method giving a bright polish. Oxalic acid in water cleans copper more quickly, but it does not give it so bright a finish. Aluminum should not be cleaned with caustics, as they quickly eat it up. Steel wool is effective, but also quickly wears away the metal.

A chemical cleaner that can be used to remove the most stubborn deposit, consists of a mixture of nine teaspoons of aluminum sulphate and one of sodium carbonate. The vessel is filled with water—if it is an aluminum pot—and one or two teaspoons of this mixture is added. After the water has been brought to a boil, the vessel will be cleaned. If it is a small aluminum object, a pot is filled with water and the object placed in it after the above salt mixture has been dissolved.—E. BADE.

Men Needed in Electricity

Good salaries and rapid advancement await trained men

NO PROFESSION offers greater opportunity to-day than Electricity. Salaries of $12 to $30 a day are not uncommon and the opportunity for advancement is unlimited.

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As Forrest Crissey said recently in *The Saturday Evening Post*—"The demand for electrical work is increasing immensely and electrical contractors assert that the supply of electrical workers cannot overtake the demand for several years to come."

Now is the time to prepare for a good position in this profitable, interesting profession.

Best of all, you can study right at home in spare time through the International Correspondence Schools—just as so many other men have done. These courses are the most authoritative courses ever offered, and have been endorsed by both Thomas A. Edison and the late Dr. Charles P. Steinmetz.

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☐ Surveying and Mapping	☐ Commercial Law
☐ Mining Engineer	☐ GOOD ENGLISH
☐ ARCHITECT	☐ STATIONARY ENGINEER
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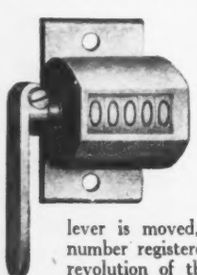
Which men or machines win out in the race for production? Those that have records to show what they've done—and *can* do!

Production-records (*Veeder* records) never stand still. They give you a basis for betterment. They challenge improvement.

At any machine that can be improved—on any job that can be "stepped up"—the *gains* start when the *COUNT* starts on a

Veeder COUNTER

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory. In the public place it counts *persons;* in the factory or store it counts *stock;* in the "open" it may count anything from cattle on a ranch, to poles on a telephone line! Registers one for each pressure of the thumb lever: counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, $5.00.

Write us about that counting problem of yours—it's probably answered in the 80-page Veeder booklet; copy free

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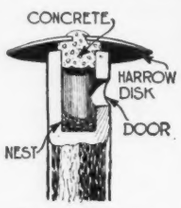
44 Sargeant St., Hartford, Conn.

Harrow Disk Forms Roof of Novel Bird-House

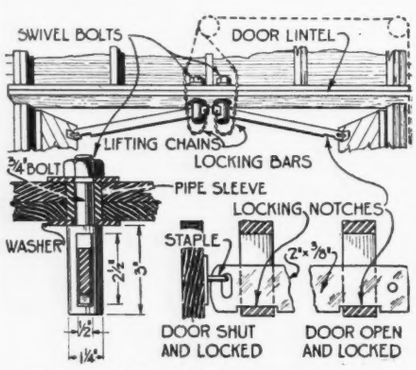
FOR birds that nest in a hollow tree, it is possible to make attractive post bird-houses like the one illustrated. Bore a large hole into the post from the top with an expansive bit, or bore several holes with a smaller bit and chisel out the opening. Then bore one or more entrance holes. Make a cover by pouring concrete in a wooden form and fastening an old harrow disk to the top. If the moist concrete is rounded over the edges of the hole in the disk, as indicated, the cover will be quite strong and it will be possible to remove it for examining or cleaning the nest cavity whenever necessary.—LOUIS SCHNEIDER, Clinton, Mo.



Post bird-house with its removable disk cover

Automatic Fasteners Hold Garage Doors Open

A SIMPLE device for holding garage doors open automatically is illustrated below. Two swivel bolts are made as detailed and fastened through the lintel or head jamb of the door. They are free to turn as the long locking bars pass through the slots in them. When the doors are opened the required distance, notches in the bars engage the bolts and act as a catch. The bars then will hold the doors open against the strongest wind.



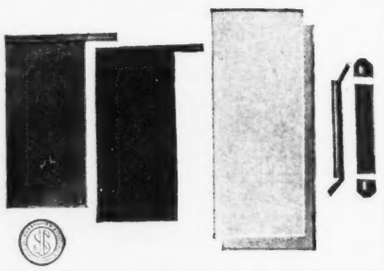
Even in a high wind the heavy garage doors are prevented automatically from closing

If the garage has a side entrance, the same bars also may be used as a lock. It is necessary merely to cut a second notch in each bar as shown, and enlarge the pivot hole to an oval. Chains or bell cords fastened to the ends of the bars and passed over pulleys provide convenient means for unlocking the doors.—F. N. C.

Trimming Drain Tile

IT IS quite a task to cut drain tile with a cold chisel, and the danger of having it break at the wrong place is ever present. A better method is to mark around the tile with a chisel where it is to be cut and then to pinch away the tile little by little with the jaws of a monkey wrench, just as glass is trimmed with the notches in a glass cutter.—JOHN L. DOUGHENY, Toledo, Ohio.

A Vital Factor



If reliability is important in the larger and more conspicuous apparatus, it is even more so in the small and often concealed parts, where a flaw will nevertheless prevent absolutely the working of the set.

That is why Kellogg miniature condensers are designed and manufactured with the same painstaking care as the famous variable condensers and other larger parts.

Our miniature condensers are all made exactly the same size mechanically, being 1⅞ inches overall, with a tip diameter of ⅜ inches. Electrically they are built in seven different capacities from 250 micro-microfarads (No. 506) up to .01 microfarad (501).

The plates are of heavy tin foil insulated by specially prepared paper of high dielectric strength. This is tightly rolled and the copper terminals soldered to the brass end pieces which are securely crimped to the fiber cover.

No. 501 .01 M. F. No. 504 .0010 M. F.
No. 502 .005 M. F. No. 505 .0005 M. F.
No. 503 .0025 M. F. No. 506 .00025 M. F.
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Medical authorities agree that 65% of all men past middle age (many much younger) are afflicted with a disorder of the prostate gland. Aches in feet, legs and back, frequent nightly risings, sciatic pains, are some of the signs—and now, a member of the American Association for the Advancement of Science has written a remarkably interesting Free Book that tells of other symptoms and just what they mean. No longer should a man approaching or past the prime of life be content to regard these pains and conditions as inevitable signs of approaching age. Already more than 10,000 men have used the amazing method described in this book to restore their health and vigor—and to restore the prostate gland to its proper functioning. Send immediately for this book. If you will mail your request to the Electro Thermal Company, 4034 Main Street, Steubenville, Ohio—the concern that is distributing this book for the author—it will be sent to you absolutely free, without obligation. Simply send name and address. But don't delay for the edition of this book is limited.

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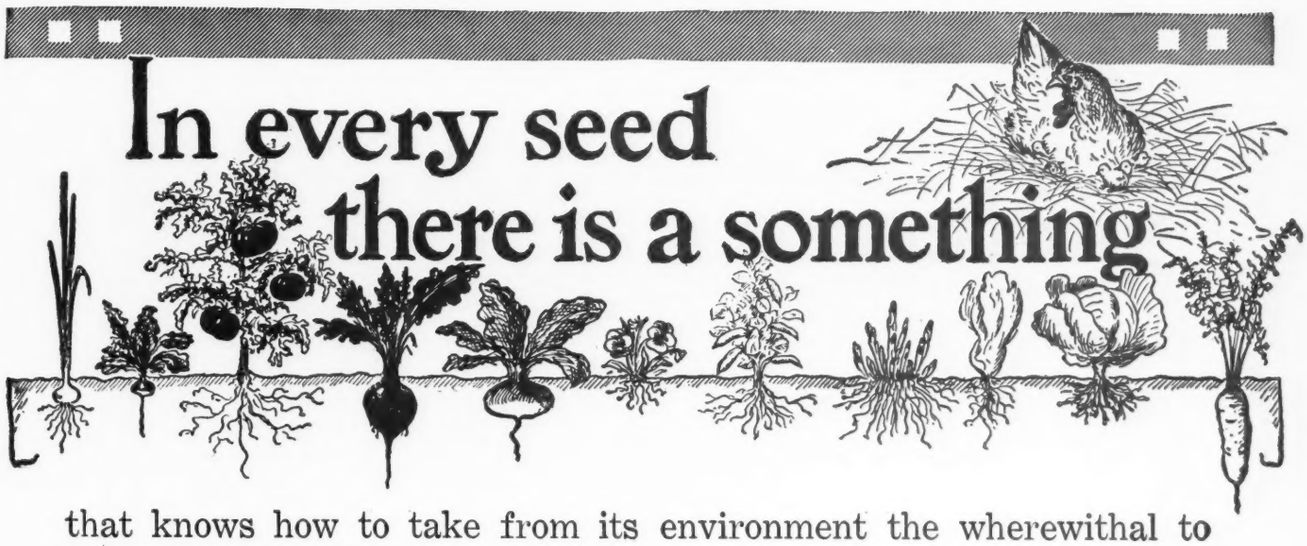
In every seed there is a something



that knows how to take from its environment the wherewithal to build the body of the organism it animates. From the little seed you place in the ground this **something** sends roots into the earth, blades or branches into the air, and takes **from** the earth and the air that with which it builds.

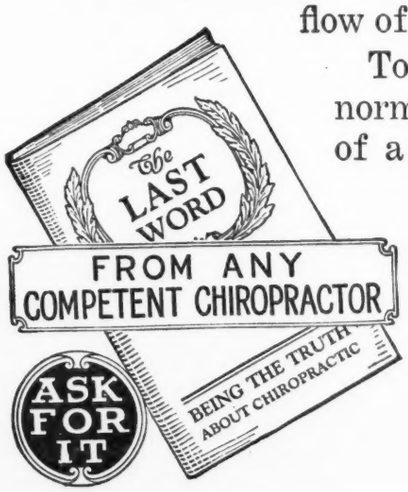
Within the egg this **something** is wooed to life by the warmth of the brooding mother's breast.

CHIROPRACTIC

teaches that this **something** knows the secret of converting food into flesh and blood, and carries on all the processes of life, in the human body, by means of impulses sent over the nerves. It teaches that when a nerve is impaired by a vertebra becoming misaligned, these impulses do not flow over the nerves normally, and the result is what we call dis-ease. To get the dis-eased member to function again it is necessary to adjust the vertebra that is pressing on the nerve, to normal alignment, thereby permitting the normal flow of impulses over the nerve.

To adjust the vertebra to normal alignment is the work of a competent chiropractor.

A trial will convince the most skeptical of the correctness of these principles.



DEFINITION

The practice of Chiropractic consists of the palpation and adjustment, with the hands, of the movable segments of the spinal column to normal position for the purpose of releasing the prisoned impulse.

Write for information regarding Chiropractors or Schools to the

Universal Chiropractors' Association
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—**Electrical Home-Service Training** with laboratory facilities, for those who cannot come to Wilwaukee.

Name.....

Street.....

City.....State.....

Age.....Education.....

Equipment for Auto-Camping

(Continued from page 75)

window in the back. The compartment thus formed serves as a kitchen and dining compartment when the drawer is extended, or as a dressing- or sitting-room when the drawer is back in place under the bedsprings. An iron tent peg at each corner holds down the drops.

In Fig. 5 (below) is a view similar to Fig. 4, except that the side drops are extended to form a windbreak.

The canvas used throughout is known as shelter-tent material and is strictly

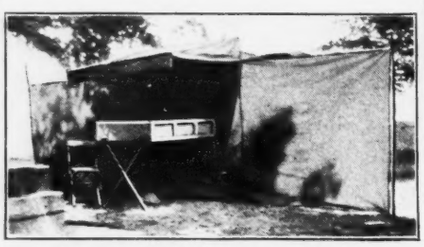

Fig. 5. The kitchen quarters with canvas spread out to form a windbreak

waterproof. The sides of the sleeping compartment are covered with screen and cheesecloth, making this compartment mosquito- and insect-proof, yet providing good ventilation. A piece of canvas may be rolled down on the inside of these sides in case of extremely stormy weather. The front panels connecting with the sides are on hinges and open in, thus giving access to the front or head of the bed when the bed is to be made up.

The drawer is covered partially with a top that slides from end to end. This top is used as a cooking and eating table. The rear of the drawer also is equipped with a 2-gallon emergency water tank, which has a small faucet at the rear.

When breaking camp, bedding, canvas, poles and ropes are placed on the mattress. These fill the triangular space formed by closing down the sides. This procedure permits of an orderly arrangement, in the drawer, of the stove, cooking utensils, food, toilet articles and a suitcase for extra clothes. When a mealtime stop is made, it is necessary only to drop the tailgate, pull out the drawer, attach the legs and prepare the meal without disturbing any material not actually to be used in the preparation of the meal.

The diagrams in Fig. 3, page 75, give the more important general dimensions.

Corroded Battery Terminals

SOMETIMES it is hard or impossible to loosen corroded storage-battery terminals. A little heat from a torch or other source, however, will usually loosen them. If a torch is not available and you have some of the wafers used on a five-minute vulcanizer, just put one of these on top of the terminal and light it. As it burns away, it will heat the terminal sufficiently. —CHARLES OLSSON, Fond du Lac, Wis.

You can build an icebox that is far superior to the average cheap commercial refrigerator and one that will save you from $10 to $25 worth of ice a year by following a remarkably simple plan in next month's Home Workshop.

"I wouldn't sell my course for ten times what I paid for it, if I couldn't get another." Norman Tompsett, Tidiaute, Pa.

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This course cuts the time of learning in half. The system is based on the methods used by famous Professor Mike Donovan, former boxing instructor at the New York Athletic Club. So quickly do pupils learn that many outbox bigger and stronger opponents after only a few weeks training.

Shadow Boxing: To prepare you for your first test, you are put through three fast rounds of shadow boxing—great exercise for producing speed, wind and confidence.

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And to build you up physically, you're given a complete set of muscle-building and breathing exercises.

SEND NO MONEY: Simply fill in and mail the coupon. When you have the course in your hands, deposit $1.67 (plus the actual postage) with the postman. Use the course for 10 days—try it out thoroughly. If for any reason, you are not entirely satisfied, return the course, and get your money back at once. Mail the coupon now to The Stillman Association, Dept. 1124-F, 50 East 42nd Street, New York.

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Send me on approval the Stillman Course. When I have the course in my hands, I will deposit $1.67 (plus the actual postage) with the postman, with the understanding that if, after 10 days, I wish to return the course, I may do so and my deposit will be instantly refunded. If I keep the course there is nothing further to pay.

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Total visible at all times. A pull of the finger clears it. Don't carry a pocket full of pencil stubs and scrap paper to do your figuring. Carry a Ve-Po-Ad.

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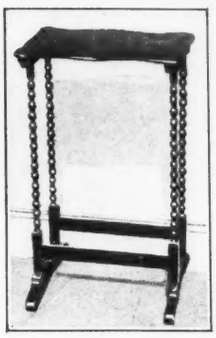
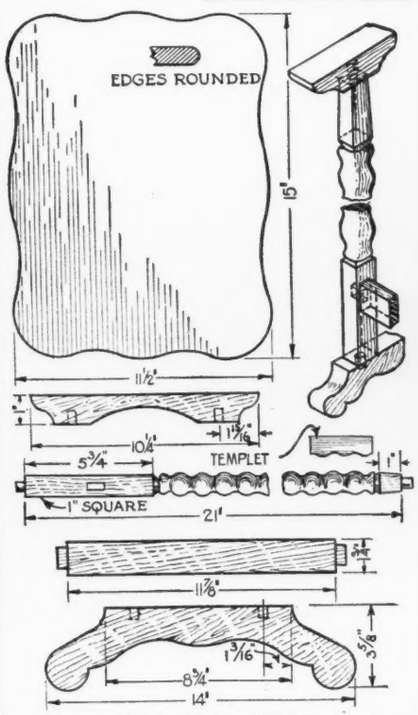
AGENTS Here's a money maker. Everybody wants one. Splendid profit. Write for special offer.

Building a Light Utility Stand with Turned Legs

USEFUL for many purposes, the light stand illustrated is graceful and delicate enough to be placed alongside the finest commercial furniture. The only machine work necessary is the turning of the legs. (The legs also can be made by hand if, instead of the design indicated, a twisted "turning" is used, as described in the April POPULAR SCIENCE MONTHLY on page 108.)



The top is ⅜-in.-thick stock, preferably mahogany, walnut, or red gum. The rails between the top and the feet are cut from 1⅛-in. stock; the lower stretchers are ⅜-in. pieces mortised and tenoned into the legs. The legs are dressed down



The completed stand and details showing shape and dimensions of the various parts

from 1⅛-in. stock to 1 in. square, 22 in. long over all and then turned as indicated with the aid of a sheet-metal templet.

The assembly may be made with a good grade of liquid glue and with wood screws carefully countersunk, the holes being filled with wooden dowels. After the glue is thoroughly hard, the piece can be cleaned up, stained, filled, and either shellacked, shellacked and waxed, or varnished, as the builder prefers.—WILLIAM J. EDMONDS, JR., Whitehall, N. Y.

TO PREVENT oil leaking at the hubs of an auto, an expert mechanic recommends removing the washers and covering them with what he calls a hard grease—a grease that does not melt easily and through which the oil cannot seep. It does not increase friction or wear.—N. G. NEAR.

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A Waterproof Bag Protects Sportsman's Camera

ALTHOUGH the camera is considered an essential on all out-of-door trips, it is apt to be a nuisance, especially when there is any strenuous action. For that reason the camera case illustrated was devised.

It is made of a double thickness of heavy canvas with edges bound with thin leather. Two leather straps are sewed on the back so that the belt may be slipped through them. A regular camera case snap-lock fastens the flap. A better case, although, of course, a more expensive one, could be made of leather.

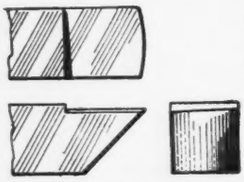
After being wrapped in a waterproof sack, the camera is placed in a bag on the belt

The inner bag is made of a thoroughly waterproof cloth, amply large enough to roll the end opening and then fold it over on itself. In this way the mouth opening is sealed.

There are several advantages in this arrangement: The camera is always at hand. The weight on the hip is scarcely noticeable. The danger of breaking is reduced to a minimum, and, finally, the camera is protected from rain or possible ducking.—LEROY WILLIAM HUTCHINS, Brewster, N. Y.

Tool for Small Lathe Makes Fine Finishing Cut

THIS excellent slide-rest tool for light finishing cuts, that will leave a smooth, clean surface, can readily be made. It is especially adapted to small lathes, hence its value to home workers.



The cutting end of the tool

Make the cutting edge broad and very slightly curved. Instead of grinding it horizontally on top, grind it at a slight angle as shown. Make the angle below the cutting edge the same as that of other tools that are found to work well.

As this tool is intended only for light cuts, it may be hardened right out and left that way, or the temper only very slightly drawn. It will then remain sharp and clean-cutting for a long time.

The main thing about a tool of this kind is to give the edge a very smooth finish. No tool will cut smoothly if the working edge is ragged.

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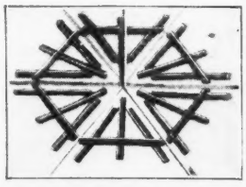
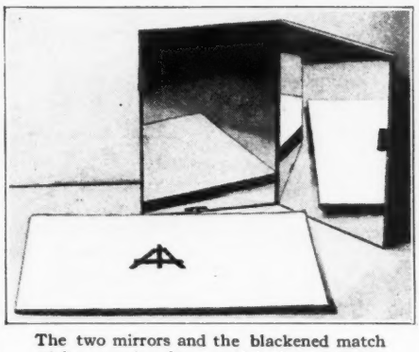
Two Mirrors Provide Original Design for Craft Work

HOME workers who are really good craftsmen often are puzzled when it comes to making a design for ornamenting some piece of wood or metal work. They do not like to copy a stock design and yet good original ideas are hard to develop. Individual and interesting stencils, inlays, marquetry, and stained or painted decorations and ornamental ironwork rarely are seen in amateur craft work.

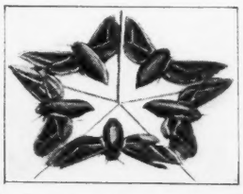


This question of originating designs can be solved quite

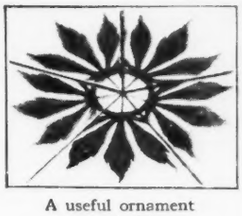


The two mirrors and the blackened match sticks used for straight-line designs

easily by using a designing machine based on the principle of the kaleidoscope. The device consists of two mirrors hinged to a common support. By placing the mirrors upon any regular or irregular design or back of several small objects regularly or irregularly arranged, a symmetrical design or ornament will be seen at the base where the two mirrors meet. The ornament can be changed simply by turning the mirrors, that is by opening or closing them. A triangular design is obtained by opening the mirrors to a wide angle. Placing the mirrors at right angles to each other provides four-sided ornaments. Closing the mirrors slightly more forms five-sided ornaments, while six-, seven-, and eight-sided designs are produced by closing them.



Insect design



A useful ornament composed of leaves

As soon as the desired design is formed, the mirrors are left standing, and the design is copied on paper. The beauty of this method of designing lies in the fact that the ornament formed will remain before one as long as necessary.—E. B.

HOW to make a trick water swing will be told next month by Dale R. Van Horn.

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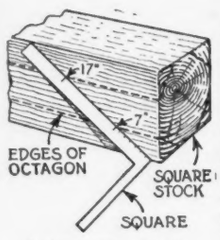
Laying Out an Octagon Quickly with a Steel Square

WHEN square stock is to be made into an octagon, the edges of the octagon can be laid out quickly with a steel square. Place the ends of the 2-ft. edge of the square at the opposite edges of the square stock, and mark at 7 and 17 in. The edges of the octagon will pass through these points. This is quicker on large work than using the so-called octagon scale on a steel square and at the same time is sufficiently accurate.—R. E. DEERING, Clements, Kan.

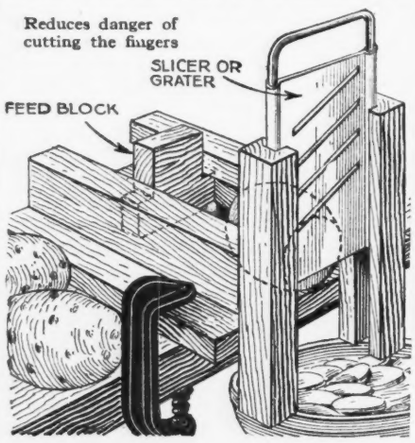


A time-saving method for heavy work

Safety Slicer and Grater

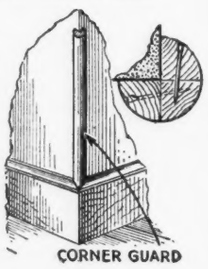
TO PREVENT the housewife from grazing or cutting her fingers when slicing potatoes or grating vegetables, a frame can be constructed to hold a plain slicer or grater such as comomnly used.

The front of the frame is grooved, as shown, to allow the tool to slide up and down. The back part of the frame is provided with a feed block. The contrivance is clamped to the edge of the table and the vegetable or other food product is placed between the block and the cutter. One hand moves the cutter up and down, while the other pushes forward the feed block. The slices or gratings drop into a pan placed on a chair directly underneath.—F. C.



Corner Guard for Walls

IN PLACE of the three-quarter round molding often used to protect exposed corners of a plastered wall, it is possible to make a very good substitute by nailing together three pieces of the much more common quarter-round molding, as indicated. Carefully nailed together and well sanded, a corner protector of this kind is almost indistinguishable from a strip of three-quarter round molding.—O. M. A.



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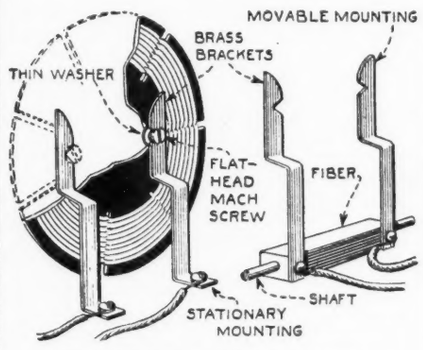
Mounting Allows Spider-Web Coils to Be Changed Quickly

THIS spider-web coil mounting was constructed for an experimental receiving set in which it was desired to change coils with the least possible trouble. Two mounts are used, one stationary and the other movable, and the coils can be snapped in and out instantly, all contacts being made automatically. This is more satisfactory than using tapped coils because the dead wire in tapped coils renders them less efficient.

Two very short flathead brass machine screws are inserted in the blank center



Strap mounting for stationary spider-web coil (at left) and for movable coil (at right)

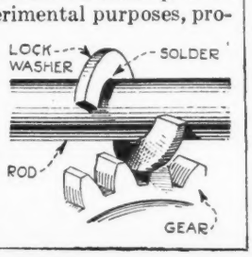
space of each spider-web form. The method of insertion is to tap the holes for the screws without running the tap clear through, so that the fit will be as tight as possible. The screws are turned in until there is only about 1/32 in. of the shank out, and the end should project on the other side about the same distance. A very thin nut or a close-fitting washer is then soldered to the end of the screw, the end of the screw and the face of the washer or nut coming flush. The ends of the winding are led to the washers and soldered to the edges, one to each washer.

The standards for the stationary coil are made of ¼ by 1/16 in. brass, with angular notches cut in the facing edges, as shown, and the edges above the notches are tapered off. The distance between the standards should be such that when the coil is snapped into place there will be sufficient pressure against the screw heads to hold the coil firmly. A flexible lead is attached to the foot of each standard.

In the case of the movable coil the arrangement is the same, except that the standards are attached to a fiber block, which is mounted on the shaft on which the assembly swings. Leads are taken from the lower ends of the brass strips in the same way as in the stationary assembly.—H. G.

Worm Made with Lock-Washer

AN AMATEUR mechanic who required a worm for experimental purposes, provided one quickly by the simple expedient of soldering a spring lock-washer on a rod, as shown. This nicely answered the purpose of a worm.—R. H. K.



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Last summer while on my vacation, which was spent on Pine Creek, one of the best fishing streams in Northern Pennsylvania, I noticed a lot of discarded Edgeworth tobacco cans. Especially were they noticeable near the good fishing holes.

When I returned home I bought Edgeworth and learned the reason for all those empty packages.

Yours,
Peter Fischler.

We're much too busy filling the blue tins here in Richmond to be able to follow them to the four corners of the earth.

It's a curious fact, by the way, that sportsmen everywhere show a marked preference for Edgeworth. There's something in the blend that strikes a responsive chord among fishermen and hunters, campers and hikers.

Perhaps some reader, himself a sportsman, can tell us why Mr. Fischler found so many Edgeworth tins "near the good fishing holes."

Be that as it may, "seeing is believing" with us just as it was with Mr. Fischler. Thousands of letters from pipe smokers are visual proof to us that in Edgeworth we are producing a tobacco that most men like.

You may not find Edgeworth to your taste at all, but we think it probable that you will. Let's try and find out!

If you'll write your name and address to Larus & Brother Company, 59 South 21st Street, Richmond, Va., we'll send you, postpaid, free samples of Edgeworth Plug Slice and Ready Rubbed.

What follows is a matter between you and your pipe!

If you care to write us the name and address of your regular tobacco dealer, we shall very much appreciate your courtesy.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

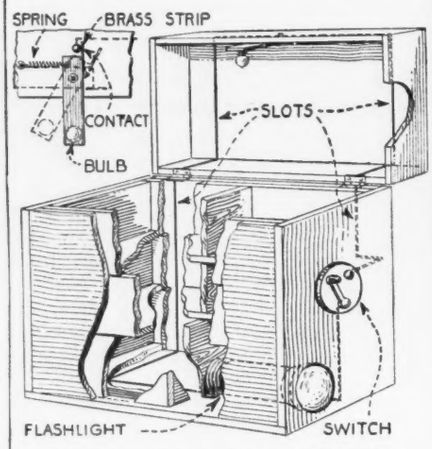
Novel Fishing Tackle Box Fitted with Electric Lights

By Edwin R. Mason

ON A recent fishing trip, I discovered a unique fishing tackle box designed for both day and night fishing. The box is about 14 in. long, 10 in. deep and 8 in. wide, made of thin, strong wood. It holds three trays, about 3 in. deep, each divided into two compartments.

The bottom tray takes up only half the length of the box; the other half is given over to housing a flashlight battery, which furnishes the power for two lights. An ordinary flashlight is fastened to the bottom, a hole being cut in the end of the box to take the bull's-eye. A small lever switch on the end operates this light.

Another bulb is fastened on a swinging wooden arm in the lid. At the pivoted end of the arm is a thin strip of brass or copper, which serves as a contact when the arm is swung out over the trays after



Two lights—one attached to the lid—make this an ideal tackle box for night fishing

the lid is raised. One wire runs from the bulb to this strip, while the other wire is coiled as shown, thus allowing the arm to be moved about.

The heavy lines in the illustration indicate shallow slots sawed in the wood before the box is put together. All wires are inserted in these slots to keep them entirely out of the way and afterward the slots are filled with putty. Contacts are made through the hinges.

With a box of this sort, the fisherman is never without a light at night. The flashlight can be switched on when the box is being carried and no other light is necessary. When a hook or sinker is wanted, all that is necessary is to raise the lid, swing out the arm, and there is light aplenty.

On the lid of the box is a brass handle that folds flush into a metal container when not in use. This allows the box to be used as a seat. Two snap fasteners, such as for suitcases, keep the lid fastened down when the box is being carried.

The sketch is given merely to show the idea; the sizes and arrangements of trays and compartments should be chosen to suit the individual fisherman, as a box to be used in Indiana would hardly be the thing in the State of Washington. The artificial bait in different places varies considerably.

PATENTS

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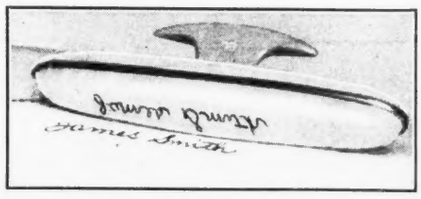
Making a Signature Stamp from an Old Nail Buffer

A NEAT facsimile signature stamp can be made f om a 10-cent nail buffer. The chamois first is removed and the packing underneath treated with typewriter stencil ink. A piece of typewriter stencil paper is prepared by writing the desired signature on it with a stylus or blunt pencil. This is placed on the inked surface of the buffer with the readable side



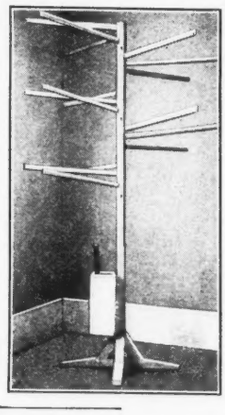
The name is written on typewriter stencil paper, which is stretched over the buffer

next to the ink and fastened with the metal band ordinarily used to hold the chamois.

The stamp is used like a rubber stamp except that no stamp pad is necessary. It will sign letters quickly and will last for hundreds of impressions. The stamp also may be used for typewritten notices in place of a rubber stamp.—K. B. MURRAY.

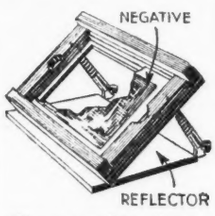
Homemade Clothes Rack

THIS homemade clothes rack will support 25 or more bars. As many bars are inserted in the mortises as are needed at one time. When the rack is not in use, all are taken out and placed in the pocket. The stand then can be pushed into a convenient corner.—A. M.



Retouching Photo Negatives on Printing Frame

NEGATIVES taken by amateur photographers often may be improved considerably by a little retouching and spotting. For this it is not necessary to purchase a standard retouching desk. Simply insert two long thin screws into the face of a printing frame, as illustrated, so that the frame will form a slanting desk. Stand it on a piece of white paper or a mirror to reflect up the light, and sit facing the light, with the lower half of the window shaded, if possible.



The retouching frame

Retouching varnish will be needed to give the negatives a "grip" for the pencil and a H.H. or harder pencil will be required. An occasional spot can be taken out with thin drawing ink and a fine brush.—E. A. M.

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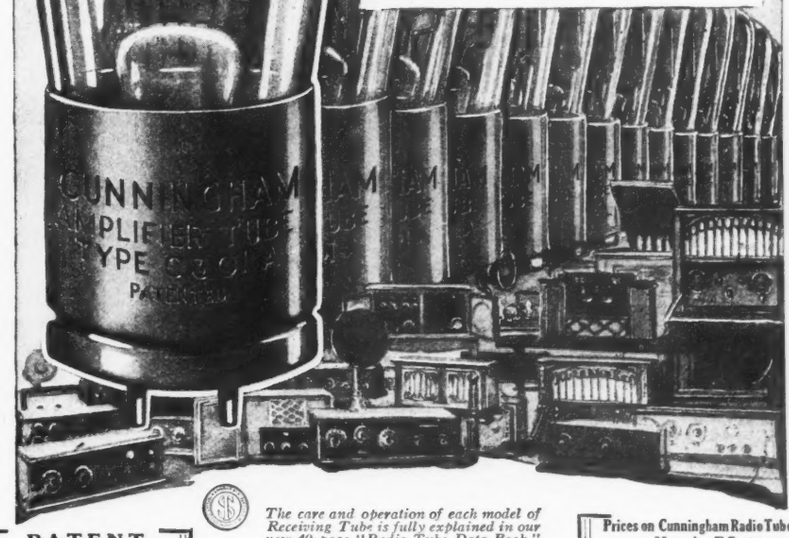

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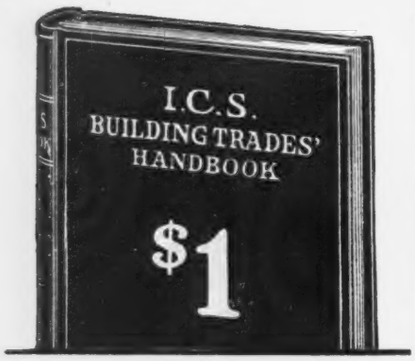

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Greatest Engineering Feats

(*Continued from page 27*)

later in the construction of what still remains the largest project of the kind ever undertaken—the Assuan Dam, which irrigates the Valley of the Nile in Egypt for its entire length of 700 miles. The Nile is one of the world's great streams, being exceeded in length only by the Mississippi. An attempt to impound the water of so large a river never before had been made.

When completed, 22 years ago, the Assuan Dam was the world's greatest reservoir and its capacity was increased 2½ times in the next 10 years. In magnitude, construction, and utility, this huge reservoir takes rank with the great public works of all time.

THE dam, which is of granite masonry set in mortar, crosses the head of the Assuan cataract of the Nile in a straight line. It is 1¼ miles long, 82 feet thick at its deepest parts, and as originally constructed was 23 feet wide at the top. Its original height from foundation to coping was 131 feet, but later 26 feet was added to this. Before it was enlarged, its capacity was 235,000,000,000 gallons—equivalent to a billion tons of water.

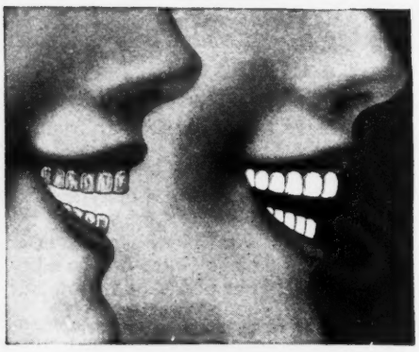
There are 180 sluice openings, to control the intake and outlet. These are opened when the river floods, and the water flows in without losing the silt it carries, an important feature, since the valley requires mud for fertilizing. When the clear flow of winter comes, the sluices are closed and the dam filled. This requires about 100 days after December first. When the water is released, it always issues from the dam at the bottom, carrying with it the enriching silt. The dam adds more than one-third to the natural flow of the Nile in times of low water.

Construction of the dam was begun in February, 1898, and it was completed in December, 1902, a full year before the specified time. This bears eloquent testimony to the smoothness and efficiency with which the work was prosecuted, despite imposing obstacles that arose from time to time.

I must mention also the Roosevelt Dam, completed in 1911, in Salt River Valley, near Phoenix, Ariz. This dam is located at the mouth of a canyon, 67 miles from the nearest railway. The materials of construction were produced almost entirely in the vicinity. Rock was blasted from 40 miles of surrounding terrain. Lumber camps and sawmills were established. Electric plants were installed. Two farms were operated to feed the workers. Even a cement mill was erected.

THOUGH neither so large nor serving so great a territory as the Assuan Dam, the Roosevelt Dam is a conspicuous achievement. It has made a vast area of waste land available for farming. It has caused land that was literally worthless to acquire a value of hundreds of dollars or more an acre. It is a mighty link in the great chain of water-storage developments that are bound to exert a profound influence on the future history of this country, since they convey to man

(*Continued on page 127*)



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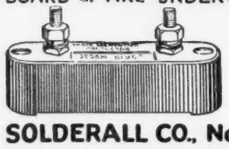

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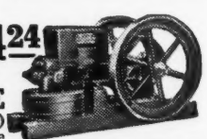

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Greatest Engineering Feats

(*Continued from page 126*)

the land from which coming generations will derive their food and clothing.

These, then, in my opinion, are the greatest engineering works of modern times. To say that they will be surpassed in the future scarcely can be called venturing a prediction. Rather it almost is to give voice to an obvious fact. Man's future demands on engineering are bound to be greater and greater, and, as in the past, it is certain that engineering skill will meet each new demand.

Already several projects of tremendous magnitude seem certain to be executed in the near future. Oddly enough, one of these amounts virtually to the reconstruction of the Panama Canal.

To make drastic improvements on this magnificent example of engineering may seem like gilding the lily; yet it is more than probable that eventually a sea-level canal across the isthmus will be necessary. Traffic through the canal is limited at present. The water of Gatun Lake is reduced 25 per cent during the dry season through evaporation and the operation of the locks. Fifty vessels can be accommodated in one day, but it is unlikely that 50 vessels could pass through every day for a year without seriously decreasing the depth of the channel, due to the amount of water needed to operate the locks.

A SEA-LEVEL canal would solve this problem permanently. Also, it would prevent the canal from being rendered useless by an earthquake or by destruction of the locks in time of war.

Another gigantic undertaking that may be expected is the construction of a tunnel or bridge across the Straits of Dover between England and France. A tunnel probably will be the means selected, although, from an engineering standpoint, a bridge would be entirely feasible. Either one would rank with the engineering marvels of all time, for the distance across the Channel is 31 miles, and the depth of the water from 90 to 165 feet.

The gigantic engineering feats that this country may see accomplished within a few years are bridges across the Hudson River at New York City and across the Golden Gate at San Francisco. Both of these projects have been discussed seriously, and one can be almost certain that some day they will be undertaken. A bridge at either city would of necessity be the greatest in the world, since spans of 3000 or 4000 feet would be included in its construction.

Thus it would appear that one need not wander far into the realms of fancy in forecasting engineering wonders for the future.

Engineers even now are giving serious consideration to the practicability of harnessing the tides. Extracting the heat from the center of the earth, storing up and utilizing the energy of the sun, transmitting electric power through great distances without wires—these are only a few of the accomplishments toward which science is gradually working. Future generations will see these things done, for the impossibility of today is the actuality of tomorrow.

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He Sees by Radio

(*Continued from page 30*)

"Curiously enough, the invention that has made the most money for me probably is the one that interested me least as an inventor. This is the spiral wound paper container for liquids that you see everywhere in grocery stores, drug-stores, candy shops, restaurants, and similar establishments.

"I was one of the first men to work out a self-starter for an automobile. Also, I built the first automobile seen in Washington—about the time that Haynes, Winton, and Duryea were doing their pioneer work. It was a steam car. I built Washington's first sight-seeing automobile, too—the first ever built in the world for all I know. In those days," reflected Jenkins with an odd smile, "I could develop an invention all right enough, but I didn't know what to do with it when I had it."

Things have changed, though, since those early days, and one needs but a cursory look about Jenkins' orderly laboratory to be convinced that the inventor has indeed become the business man. His shops and workrooms are spic and span as the decks of a battleship—and they are filled with young women and young men.

"GIVE me the young men," he said enthusiastically. "The young experimenter doesn't know enough to be afraid of failure. Given a difficult mechanical problem, an older man is likely to permit formulas to convince him that the thing is impossible, and surrender without a fight. The young man, though, hasn't time to bother with incomplete formulas. While the older man is poring over them, the young man has finished the job that was theoretically impossible. In that one respect, I've remained young myself."

Jenkins is about 55 years old. He looks like a professor, but talks like a business man—in quick, incisive phrases that express his meaning exactly. Midnight labor has no terror for him. Twenty-four hours a day fit into his routine without friction.

In the face of this custom of continued labor it is not odd that he is a stranger to the usual recreations of the tired business man. He has a single hobby—aviation. From March to November he pilots his own airplane in flights in the vicinity of Washington, and says he finds two hours in the air a more satisfactory vacation than two weeks on the ground. Mrs. Jenkins is his frequent companion in flight.

If radiovision succeeds, Jenkins will join the very select list of inventors who have achieved two great inventions. Ordinary pictures Jenkins now can project by radio over distances limited only by the power of the broadcasting station to which his instruments are attached. Moving pictures, too, though with less fidelity to the original. But in the transmission of actual scenes he is limited now to silhouettes—black and white pictures.

This, though, he declares, eventually will give the halftone values also, and I accept his word. His Quaker father taught him not to boast, and, after the astonishing things I saw the other day in his laboratory, I am ready to believe anything told me by the man who created moving pictures.

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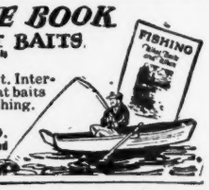

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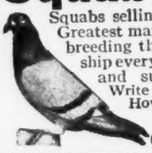

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AUTO SUPPLIES

Nature's Magic in Radium

(*Continued from page 43*)

astounding feat the wonder element performs—transforming itself from one substance into another entirely different through the alchemy of nature. The way in which what may be called the radium family produces its successive generations indeed is amazing.

Old Father Uranium, parent of this remarkable family, goes through a series of changes, becoming what chemists call Uranium X_1, Uranium X_2, and Uranium 2, then Ionium, and eventually Radium. Then Radium goes through its own series of metamorphoses, becoming polonium, and at last Lead.

In all, there are 16 more or less long-lived and sturdy generations between Uranium and Lead, and, as may be assumed, the process is not completed speedily. As a matter of fact, it takes more than 6,000,000,000 years!

RADIUM'S amazing property of transforming itself slowly into lead naturally raises the question whether, eons ago, the earth may not have had a superabundant supply of radium; whether, in short, all the lead in the world today may not have been pure radium. Possibly, although science says that if this ever was so, the earth was a place vastly different from the earth we know. It must have been a tiny, flaming sun, or possibly a part of the sun.

The latter hypothesis frequently is offered as explaining the origin of our earth. It assumes that the earth is a piece hurled from the sun or some other giant heavenly body, and that its surface, gradually cooling, became inhabited by the "life spores" that had been floating through the ether.

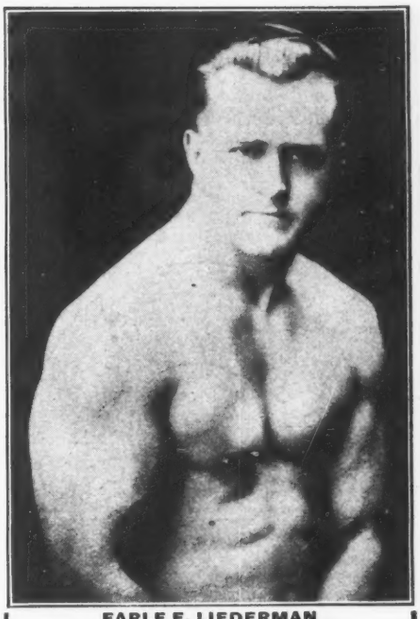
If there is anything in this theory, we may wonder whether the life spores themselves may not have been emanations from radium; for science has demonstrated conclusively that radio-activity bears a distinct relation to the very elements of life. For example, certain seeds subjected to the action of radium rays, produce plants of unusual vigor with extraordinary rapidity.

The reason science believes radium never existed on earth in any large quantities in a free state is because its chemical properties would seem to make that impossible. Obtaining pure radium is exceedingly difficult, and it is virtually impossible to keep it pure because of the avidity with which it reacts with air. In consequence, commercial radium is produced only in the form of its salts—the bromide, the chlorid, the carbonate, and the sulphate.

Radium's principal practical use, aside from its employment in making luminous paints, has been for medical purposes. The possibility that radium might be useful in medicine occurred to Pierre Curie, husband of its discoverer, in 1901. Even before that Becquerel, suffering a severe burn when he carried a tube of radium in his waistcoat pocket, noted its peculiar action on the body tissues.

Henri Dominici, however, must be called the father of radium therapy. In 1906 he discovered that radium rays,

(*Continued on page 130*)



EARLE E. LIEDERMAN
as he is today

How Strong Are You
Can You Do These Things?

Lift 200 lbs. or more overhead with one arm;
Bend and break a horse shoe;
Tear two decks of playing cards;
Bend spikes;
Chin yourself with one hand.

Can you do any of them? I can and many of my pupils can. It is remarkable the things a man really can do if he will make up his mind to be strong—*any man.* It is natural for the human body to be strong. "It is criminal to be weak." I have taken men who were ridiculed because of their frail make-up and developed them into the strongest men of their locality.

I WANT YOU FOR 90 DAYS

These days call for speed. It once took four weeks to cross the ocean—now it takes less than one. In olden days it took years to develop a strong, healthy body. I can completely transform you in 90 days. Yes, make a complete change in your entire physical make-up. In 30 days I guarantee to increase your biceps one full inch. I also guarantee to increase your chest two full inches. But I don't quit there. I don't stop till you're a finished athlete—a real strong man. I will broaden your shoulders, deepen your chest, strengthen your neck. I will give you the arms and legs of a Hercules. I will put an armor plate of muscle over your entire body. But with it comes the strong, powerful lungs which enrich the blood, putting new life into your entire being. You will have the spring to your step and the flash to your eyes. You will be bubbling over with strength, pep and vitality.

A Doctor Who Takes His Own Medicine

I was a frail weakling myself in search of health and strength. I spent years in study and research, analyzing my own defects to find what I needed. After many tests and experiments, I discovered the secret of progressive exercising. I increased my own arm over 6¼ inches, my neck 3 inches and other parts of my body in proportion. I decided to become a public benefactor and impart this knowledge to others. Physicians and the highest authorities on physical culture have tested my system and pronounced it to be the surest means of acquiring perfect manhood. Do you crave a strong, well-proportioned body and the abundance of health which go with it? Are you true to yourself? If so, spend a pleasant half hour in learning how to attain it. The knowledge is yours for the asking.

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It contains forty-three full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now, before you turn this page.

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Nature's Magic in Radium

(*Continued from page 129*)

filtered twice through lead, destroyed tissues affected by such diseases as cancer or tumor, but apparently were not harmful to healthy tissues.

Since then radium has been employed in the treatment of many diseases, including cancer, tumors, rheumatism, gout, neuralgia, sciatica, lumbago, diabetes, anemia, cholera, and typhoid. It is said to cure burns caused by X-rays. It is said also to retard the growth of the bacteria of typhoid, cholera, and anthrax, to increase the appetite and the power of digestion, and to aid the chemical processes of the body.

And still, after using radium for almost a score of years, medical science is divided as to whether radium actually constitutes a cure of disease. It is recognized as most valuable in relieving pain. But it is so unlike other weapons of medicine that physicians have not yet developed a definite technic in employing it.

TOO lengthy exposure to radium undoubtedly will do more harm than good. Though protected by lead shields, those who work with radium are liable to severe disorders. The rays of radium exert no immediate painful effect, but they cause a reduction in both the red and white corpuscles of the blood, low blood pressure, and often anemia. The fingernails become brittle, the surrounding cuticle ragged and sore, and the skin of the face and hands is inflamed.

In the radium treatment of disease, quantities of the wonder element in amounts less than a gram are of little value. Now, with only about 100 grams in the world, obviously there is not enough to go around, so the available supply is made to serve every one by a highly ingenious method.

The emanations of radium are put up in capsule form. A small quantity of radium bromide or radium chlorid is placed in a flask, and the emanations are led through a bewildering array of glass pipes into a tiny capillary tube. When a desired amount of the emanation has collected in this tube, it is broken off in tiny bits, possibly one quarter as large as an ordinary pin, and the ends of these are fused by a blowpipe.

These little tubes are called radium "seeds," and they are supplied to physicians at about five dollars each. The radium emanation they contain retains its strength for about four days. The "seeds" are injected directly into the body by a sort of spring gun.

What new knowledge of radium the future may bring, in what new ways its marvelous properties may be bent to the service of humanity, no man can predict.

Science eventually may develop a new, easy method of extracting radium from the minerals that contain it. The geologists' theory that the interior of our earth is a vast mine of radium, may be substantiated some day, and that mine may be tapped to supply through the enormous energy of radium man's every need for power, light, and heat. It is a prospect scarcely less fanciful than a prediction regarding the present wide use of electricity would have been a century ago!

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Portable Radio Receiver

(*Continued from page 68*)

ment of from 200 to 400 ohms. Numbers 8 and 10 are the rheostats with fine control. Tubes 12 and 16 are controlled by rheostat 8, while tubes 21 and 24 are controlled by rheostat 10.

Number 9 is a double-circuit jack, while No. 11 is a single-circuit jack. Anti-capacity jacks were used to conserve space.

Numbers 12, 16, 21, and 24 are the tube sockets. The designations *F1* and *F2* have been assigned arbitrarily to the filament terminals merely to avoid confusion in wiring. It makes no difference which filament terminal is called *F1* or *F2*.

Numbers 13 and 17 are radio-frequency transformers. These should be of a type designed to cover the entire broadcasting range.

NUMBERS 14 and 27 indicate the screws and nuts used to fasten the baseboard of the set to the cover of the suitcase. Two other fastenings are used close to the panel edge of the baseboard. Washers should be used on the outside of the case to prevent tearing of the cover.

Number 15 is the positive B battery binding post. Numbers 18, 22, and 23 are audio-frequency transformers. Number 18 may have a high ratio, but numbers 22 and 23 should be of the low ratio type.

Number 19 is the crystal-detector mounting. Number 20 is a .001-microfarad fixed condenser.

Number 25 is the positive A battery and negative B battery binding post, while No. 26 is the negative A battery post.

In the radio-frequency transformers, the primary terminals are indicated by the letter *P*, while the secondary terminals are indicated by the letter *G*. The terminals on each side of the letter are those of the winding indicated by the letter. The number 2 refers to the outside terminals of the windings, while the number 1 refers to the inside terminals of the coils. If your transformer terminals are marked *P*, *B*, *G* and *F*, the *P* corresponds to *P2;* the *B* corresponds to *P1;* the *G* corresponds to *G2*, and the *F* to *G1*. In some audio transformers the letter *A* is used to denote one terminal of the secondary winding. In others, the letter *F* is used.

SWITCH 3 is provided with seven switchpoints; switch 5 with eight. The last switchpoint of switch 8, that is, the one nearest the bottom of the panel, is left unconnected. It merely provides a means of disconnecting the switch-arm of switch 5 from coil 4. When the set is to be used with a loop aerial, it is not desirable to use the coil in parallel with the loop. By setting switch-arm 5 on the blind contact, the coil is disconnected from the circuit.

Each switchpoint of one switch is connected with the corresponding switchpoint of the other. Each tap of the tuning coil then is connected with the switchpoint connectors, so that in effect each tap of the coil is connected with a switchpoint of each switch. In this way each switch can be connected with any tap of the coil.

(*Continued on page 132*)

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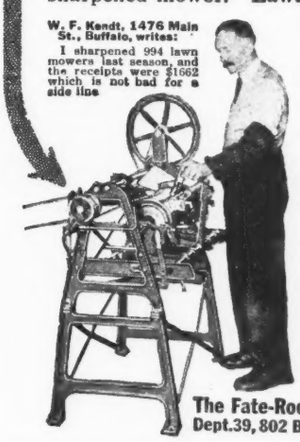

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Simply send your name, postcard will do, we will mail you postpaid, CLEAR, POSITIVE, SIMPLE instructions that you can begin applying IN A VERY FEW HOURS. You have five days to study and examine it without cost. If it proves valuable in obtaining concrete results we leave it to you to pay us within 5 days what in your judgment it is actually worth to you or what you honestly can afford to pay. If you think it is worth nothing, pay nothing, simply return it. This plan seems strange and unusual. But the power and secret are ALSO strange and unusual. You WRONG only yourself if you delay.

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Portable Radio Receiver

(*Continued from page 131*)

After the taps are connected with the switchpoints, the top end, or zero tap, of the winding is connected with the *G* terminal of socket 12 and the *A*, or stationary plate, terminal of condenser 6.

THE aerial post 1 is connected with the switch-arm of switch 3. A wire then is used to connect the following terminals in the order named—the ground post 2; the switch-arm of switch 5; the B terminal of potentiometer 7; the rotary plate terminal *B* of condenser 6, and the *G1* terminal of transformer 13.

Next, lead a wire along the bottom of the set, connecting post 25 with the *C* terminal of potentiometer 7. Branches then are used to connect this wire with the *F1* terminals of sockets 21 and 24.

Another wire is run along the back of the baseboard, connecting post 25 with the *F2* terminal of socket 12. With this wire the *F2* terminal of socket 16 is connected.

The next step is to connect the negative A battery post 26 with the A terminals of rheostats 8 and 10, and with the A terminal of the potentiometer. The A terminals of transformers 22 and 23 are connected with this wire by short lengths.

A wire running along the baseboard connects the *B* terminal of rheostat 8 with the *F1* terminals of sockets 12 and 16. Another wire connects the *B* terminal of rheostat 10 with the *F2* terminals of sockets 21 and 24.

NOW connect the *P* terminal of socket 12 with the *P2* terminal of transformer 13. The *G2* terminal of transformer 13 is connected with the *G* terminal of transformer 18. Then connect the *G* terminal of socket 16 with the *A* terminal of transformer 18.

The *G2* terminal of transformer 17 is connected with the catwhisker terminal *B* of crystal-detector mounting 19, while the *A* or crystal terminal of the mounting is connected with the *P* terminal of transformer 18. The detector circuit is completed by connecting the *G1* terminal of transformer 17 with the *B* terminal of transformer 18.

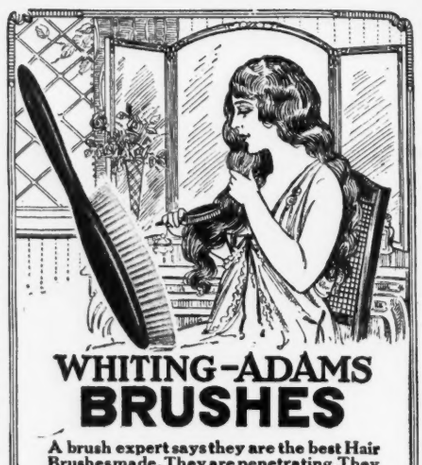
Now connect the *P* terminal of socket 16 with the *P2* terminal of transformer 17; the *G* terminal of transformer 22 with the *G* terminal of socket 21; the *G* terminal of transformer 23 with the *G* terminal of socket 24; the *P* terminal of socket 21 with the *P* terminal of transformer 23; the *P* terminal of socket 24 with the *A* terminal of jack 11.

Now you can run a bus wire practically the length of the set to serve as the common connector by which the terminals of the various instruments are connected with the positive of the *B* battery.

Start the wire at binding-post 15; run it to terminal *P1* of transformer 13, then over the center of the baseboard and above the set to the *B* terminal of transformer 23. Then connect the *B* terminal of jack 11 with the *A* terminal of jack 9 and with the B battery bus wire mentioned in the preceding sentence.

The *P1* terminal of transformer 17 is

(*Continued on page 133*)



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Portable Radio Receiver

(*Continued from page 132*)

connected with one of the outside terminals, *B*, of jack 9.

One of the inside terminals, *D*—the one that makes contact with the outside spring *B* of jack 9—is connected with the *P* terminal of transformer 22. The other inside terminal *C*, making contact with outside spring *A*, is connected with terminal *B* of transformer 22.

THE wiring is completed by connecting the fixed condenser 20 into the plate circuit of tube 16. One terminal of the condenser is connected with the lead connecting the *P1* terminal of transformer 17 with the *B* terminal of jack 9. The other is connected with the lead to the positive B battery post 15.

In some cases you may find it necessary to connect a fixed condenser of about .00025 microfarad between terminal *G2* of transformer 13 and the *G* terminal of tube 16.

For the battery connections, the negative of the A battery is connected with post 26; the positive A battery and negative B battery terminals with post 25, and the positive terminal of the B battery (from 45 to 90 volts) with post 15.

The crystal detector is the very heart of the receiver, so it is very important that a good, sensitive crystal be used.

TO CHANGE the circuit into one having one stage of transformer-coupled radio-frequency amplification, a vacuum-tube detector, and two stages of straight audio-frequency amplification, it is necessary only to lift the catwhisker from the crystal, disconnect the secondary leads of transformer 18 from the grid circuit of tube 16 and connect into the break between the *G2* terminal of transformer 13 and the *G* terminal of tube 16, a standard grid condenser and leak.

The set is tuned much as any other standard set. The approximate setting for wave length is obtained by the two inductance switches, and the finer adjustment by using the variable condenser. The signals can be cleared and brought in with greater volume by adjustment of the potentiometer and filament rheostats. The programs then can be brought in with best results by readjusting the crystal to its point of greatest sensitivity and by slightly readjusting the other controls.

If the regulation type of wire aerial is used, the aerial is connected with the aerial post 1 and the ground or counterpoise is connected with post 2. If a loop aerial is used, one end should be connected with the aerial post 1 and the other end with the ground post 2. When a loop aerial is used, switch 5 should be set on the blind contact so as to disconnect coil 4 from the circuit.

If you prefer dry-cell tubes when using the set as a portable outfit, and the storage-battery tubes when using it at home, adapters can be used. When the summer tour is over, the receiver can be mounted in a cabinet.

IN NEXT month's issue Mr. Calcaterra will tell how to build an unusually light combination portable receiver, using either one or three tubes.

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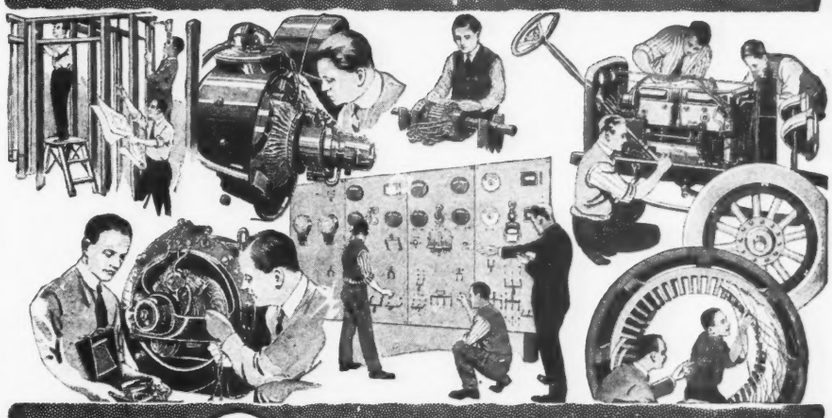

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Back of every great step in woman's progress from a drudge to a free citizen has been some labor-saving invention. Back of most inventions in electricity's progress from a mystery to a utility has been the research of General Electric Company scientists and engineers.

GENERAL ELECTRIC

Here Are Correct Answers to Questions on Page 64

1. No. A balloon rises because it is lighter than air. But the air gets thinner, therefore lighter, as one goes up. The balloon will rise only until it is as heavy as the air it displaces.

2. Because their leaves cannot get enough water. The air in the house is warm and dry and the leaves dry out. The stem of the fern is small and does not contain enough water tubes to supply the fern.

3. Because the back part of the eye has the property of reflecting light much as a mirror does. If you stand in a lighted doorway and a cat in the dark looks at you, the light from the doorway is reflected in the cat's eyes.

4. At one place you can see two or three thousand. From all over the earth about 6000 stars are visible.

5. There is no evidence that they do. They are indications sometimes of the forgotten past, but not of the future.

6. One of its main functions is to control the amount of sugar in the blood. When you eat sugar, it is absorbed and carried to the liver. The liver converts it into a substance called "glycogen." Then when the muscles need more sugar for food, the liver converts a little of this glycogen back into sugar and releases it into the blood so that it can be carried to the muscles.

7. Salt has the power of lowering the temperature of melting ice. The mixture of salt and ice gets much colder than mere ice and water would get.

8. No. It has none of the characteristics of living matter. It is merely a secretion produced by the living hair cells in the scalp.

9. Uranium is one of the elements like radium, the atoms of which explode and produce atoms of lead. The percentage of the atoms that explode in a second or in a century is known. Accordingly, if you know how much uranium and how much lead there is in a certain sample of rock, you can calculate just how many years it has taken that much uranium to produce that much lead. Calculations like this for the earliest known rocks give an age of about 1,600,000,000 years. The earth as a whole is, of course, older than these rocks. It may be as much as six or eight billion years old.

10. Helium, the non-inflammable gas now used for filling airships. This was discovered in the sun in 1868 by the spectroscope, but was not found anywhere on earth until 1895.

11. Chloroform has an unusually strong affinity for nervous tissues, including the tissue of the brain. It collects there and affects this tissue so that nerve impulses can no longer pass through it, neither pain sensations through nerves, nor thoughts through different parts of the brain. After a certain period, the blood slowly removes the chloroform from the nervous tissue and the nerves and brain are able to work again.

12. Heat is due to the vibration of the molecules. When a substance gets hotter, the molecules in it vibrate faster. This pushes them a little farther apart and pretty soon they get so far apart that their fixed positions are lost and the substance becomes a liquid.

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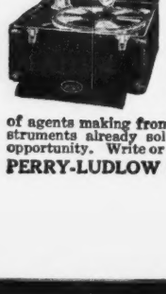

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Adventures in Home Ownership

(*Continued from page 45*)

closet are reached. The dining-room is about the same as in the other plans."

Marion now had the last sheet spread out.

"UPSTAIRS," she went on, "you see there's a fine big, well lighted owner's chamber with two closets and a storage room in the gable over the maid's room. There's a linen closet in the hall, the bathroom at the rear as before, also two more good chambers with a closet each."

"That about completes the case for this house, I believe," said Jim. "What's the verdict?"

"Again very favorable," I replied.

"But which house do you like best?" Marion asked rather impatiently.

"As houses, I like them all," I answered. "For your needs, however, it seems to me, that all three cases ought to be reconsidered together."

"That's true," said Jim. "But couldn't one of these houses be used as the basis for slight alterations?"

"That's just what I wanted to suggest," I replied. "The last house you have shown me is distinctive, picturesque, and good, but it seems to me that the simple dignity of the second one—the quaint lean-to type—will continue to please you longer than the other, and the floor plans are simpler, better, and give you more. With slight alterations, which your architect would charge little for, you could have everything you need and the whole house probably could be built for about $12,000, fully equipped."

"How would you change the plan?" asked Jim.

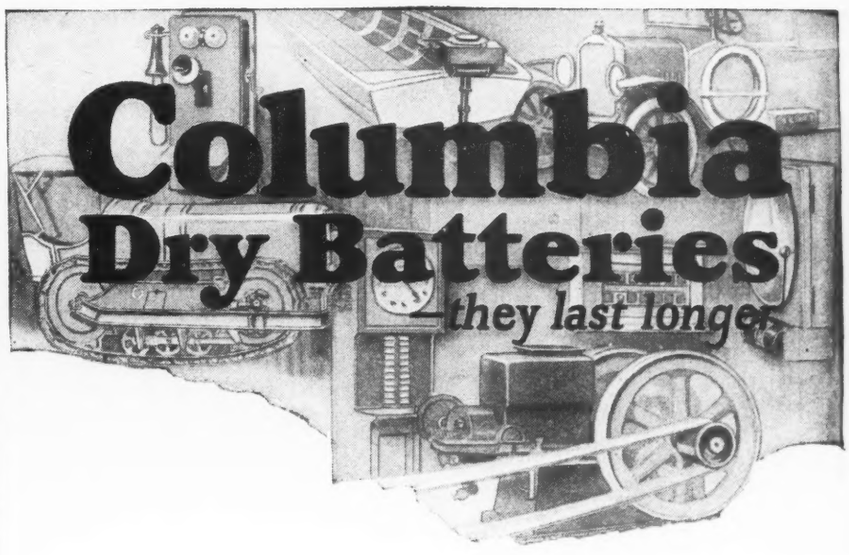
"Well," I explained, "first to give Marion the sun porch she desires so much. You might inclose the large open porch in glass. Then, to have an open porch in addition, you could borrow the very ingenious rambling idea of the third house—join the garage with the dining-room by means of an attractive covered porch. This will make the house look larger, add to its attractiveness, and at the same time give you a sheltered passage from the house to the garage.

"Again, I noticed that Marion was greatly attracted by the built-in sewing-table, which converted the front end of the upstairs hall of the first house into a sort of sewing-room. You might do the same thing with the light and roomy dressing-room adjoining the owner's chamber in this second house. It would make an ideal sewing-room.

"These are just a couple of suggestions for slight alterations to give you what you want. Probably others will occur to you before you start to build."

"By George," exclaimed Jim, "you've hit the nail on the head! I'll get the architect started on the alterations tomorrow. Meanwhile we'll look at some lots both near-by and a little farther out."

Read in next month's issue how Jim and Marion let the contract for building their permanent home and how the house was equipped.



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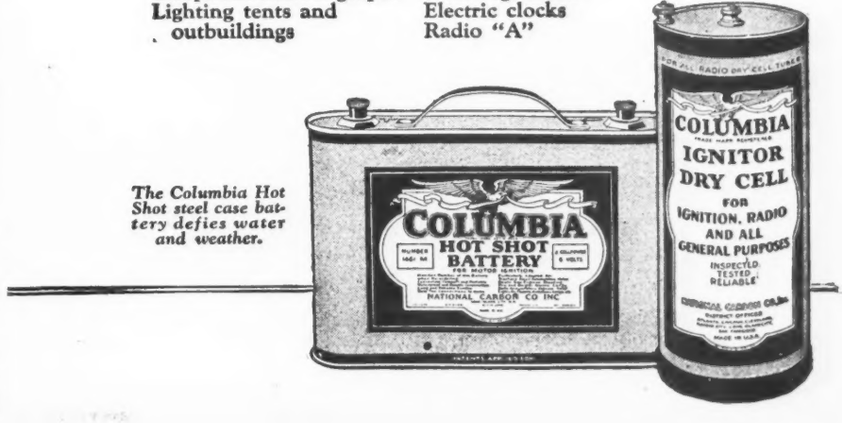

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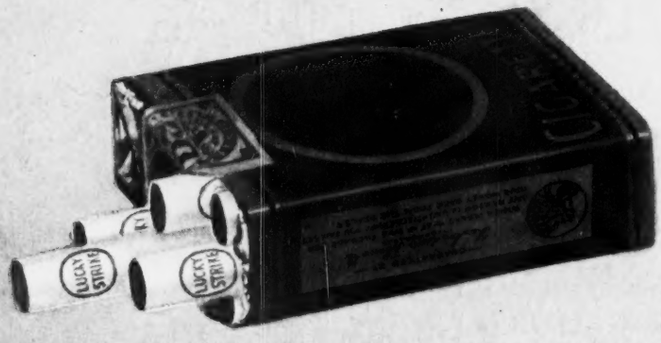

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